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A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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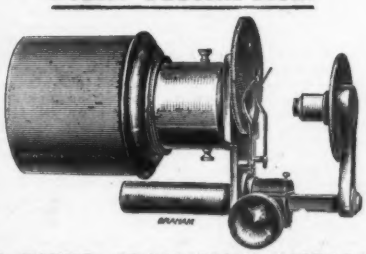

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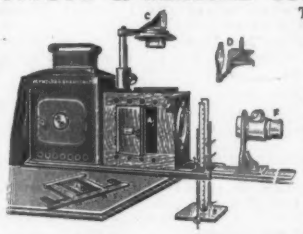

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LECTURE ARRANGEMENTS AFTER EASTER, 1920.

COURSE OF LECTURES AT THREE O'CLOCK, AFTERNOON.

TUESDAYS.

Major G. W. C. Kaye, D.Sc.—Two Lectures on "Recent Advances in X-Ray Work." Tuesdays, April 13, 20.

Arthur Keith, M.D., F.R.S.—Four Lectures on "British Ethnology—The Invaders of England." Tuesdays, April 27, May 4, 11, 18.

Major C. E. Inglis.—Two Lectures on "The Evolution of Large Bridge Construction." Tuesdays, May 25, June 1.

THURSDAYS.

Sidney Skinner.—Two Lectures on (1) "Ebullition and Evaporation," (2) "The Tensile Strength of Liquids." Thursdays, April 15, 22.

R. Campbell Thompson, F.S.A.—Two Lectures on (1) "The Origins of the Dwellers in Mesopotamia," (2) "The Legends of the Babylonians." Thursdays, April 29, May 6.

A. P. Graves.—Two Lectures on "Welsh and Irish Folk Song" (with musical illustrations). Thursdays, May 13, 20.

William Archer.—Two Lectures on "Dreams, with Special Reference to Psycho-Analysis." Thursdays, May 27, June 3.

SATURDAYS.

W. H. Eccles, D.Sc.—Two Lectures on "The Thermionic Vacuum Tube as Detector, Amplifier, and Generator of Electrical Oscillations." Saturdays, April 17, 24.

Frederick Chamberlin, LL.D.—Two Lectures on "The Private Character of Queen Elizabeth." Saturdays, May 1, 8.

Frederic Harrison, D.C.L., D.Litt.—Two Lectures on (1) "A Philosophical Synthesis as Proposed by Auguste Comte," (2) "The Reaction and the Critics of the Positivist School of Thought." Saturdays, May 15, 22.

J. H. Jeans, LL.D., Sec.R.S.—Two Lectures on (1) "The Theory of Relativity," (2) "The Theory of Quanta." Saturdays, May 29, June 5.

Subscription (to Non-Members) to all Courses of Lectures, Two Guineas. Subscription to a Single Course of Lectures, One Guinea, or Half-a-Guinea. Tickets issued daily at the Institution, or sent by post on receipt of Cheque or Post-Office Order.

The Friday Evening Meetings will commence on April 16, at 9 p.m., when J. A. McClelland will give a Discourse on "Ions and Nuclei." Succeeding Discourses will probably be given by H. Maxwell Lefroy, F. O. Bower, The Right Hon. Lord Rayleigh, Karl Pearson, J. A. Fleming, W. L. Bragg, and other Gentlemen. To these Meetings Members and their Friends only are admitted.

Members are entitled to attend all Lectures delivered in the Institution, the Friday Evening Meetings, and the Libraries, and their families are admitted to the Lectures at a reduced charge. Payment: first year Ten Guineas, afterwards Five Guineas a year; or a composition of Sixty Guineas.

Persons desirous of becoming Members are requested to apply to the Secretary.

LONDON COUNTY COUNCIL.

DAY CONTINUATION SCHOOLS.

The Council invites applications from men and women desiring to become ASSISTANT TEACHERS in the Day Continuation Schools to be established under the Education Act, 1918.

Owing to the varied character of the work of these schools, applications will be considered from experienced teachers and from University graduates, social workers, well-educated persons experienced in commerce or industry, Army instructors, and other persons not holding the usual professional qualifications. Applicants may be required to undergo a course of training, which will vary in length according to their qualifications and experience. No fees will be charged for the course of training.

The scales of salaries for Assistant Teachers appointed for full time in these schools will be in accordance with the Council's scales for the time being for teachers in (1) Central Schools, (2) Secondary Schools (High Scale), (3) Technical Institutes, according to the qualifications prescribed for these scales.

PART-TIME ASSISTANT TEACHERS will also be required; the remuneration for these teachers will be in accordance with the rates for part-time instructors in the evening institutes.

In the case of men candidates preference will be given to those persons who have served, or attempted to serve, with the Forces of the Crown.

Apply, enclosing stamped addressed foolscap envelope, to the Education Officer (T.3), London County Council Education Offices, Victoria Embankment, W.C. 2; Form T.3.1, giving particulars, will then be sent, and must be returned by 11 a.m. on March 31, 1920. Canvassing disqualifies.

Teachers already in the service of the London County Council under any one of the scales of salary referred to above, who are selected for whole-time permanent employment in Day Continuation Schools, will be transferred at salaries not lower than their existing salaries, and, subject to the satisfactory completion of the period of probation, will be allowed any increment due as from the anniversary of their previous increment.

JAMES BIRD,
Clerk of the London County Council.

UNIVERSITY OF EDINBURGH.

Chancellor—The Right Hon. A. J. BALFOUR, O.M., D.C.L., LL.D., &c.
Rector—Admiral The Right Hon. EARL BEATTY, O.M., G.C.B., G.C.V.O., D.S.O.
Principal and Vice-Chancellor—Sir J. ALFRED EWING, K.C.B., M.A., D.Sc., LL.D., F.R.S.
Secretary to the University—WILLIAM WILSON, M.A., LL.B., Advocate.

The SUMMER SESSION extends from about the middle of April to the end of June; in Law, from May to July. The WINTER SESSION opens about the beginning of October and closes about the middle of March.

The University embraces SIX FACULTIES, viz. ARTS, SCIENCE, DIVINITY, LAW, MEDICINE AND SURGERY, and MUSIC, in all of which full instruction is given and Degrees are conferred. There are many different avenues to the DEGREE OF M.A. (Honours and Ordinary), the graduation subjects embracing English, History, Modern Languages, Science, &c., besides Ancient Languages, Philosophy, Mathematics, &c. The wide scope of the Arts Curriculum permits of the combination of Arts, Science, Medical, or Special Studies; and it has been shown by successes of Edinburgh students in the Civil Service Examinations that it is possible to combine study for Degrees in Arts, Science, or Law with preparation for this and other Special Examinations. In addition to the Ordinary and Honours Degrees in Arts, the Higher Degrees of D.Litt., Ph.D., and D.Sc. are conferred. The Degree of BACHELOR OF EDUCATION is conferred on candidates who have attended courses and passed examinations in Psychology and in Education (theoretical and practical). A Diploma in Education is also conferred. A Degree of BACHELOR OF COMMERCE (B.Com.) has been recently instituted, and Special Courses in various commercial subjects have been provided. DIPLOMAS are granted in GEOGRAPHY and in ACTUARIAL MATHEMATICS. Degrees in SCIENCE (B.Sc. and D.Sc.) may be taken in PURE SCIENCE, ENGINEERING, PUBLIC HEALTH, and VETERINARY SCIENCE; and the Degree of B.Sc. in AGRICULTURE and FORESTRY. Temporary Regulations have been framed for a DIPLOMA and a CERTIFICATE IN FORESTRY for the behoof of officers and men who have served in the war. There are fully equipped Science Laboratories, and other necessary appliances, in all these Departments. The curriculum in DIVINITY affords a thorough training in Theological subjects, and the Degree of Bachelor of Divinity (B.D.) is conferred. The LAW Faculty, besides furnishing the professional equipment necessary for those intending to practise in Scotland, contains Chairs in Jurisprudence and Public International Law, Constitutional Law and Constitutional History, Roman Law, and Political Economy, as also Lectureships in other important branches of Law, and is thus adapted for students preparing for the Civil Service Examinations, and for legal, political, and administrative appointments generally. The Degrees of Bachelor of Laws (LL.B.) and Bachelor of Law (B.L.) are conferred. The Faculty of MEDICINE has a full curriculum in Medicine and Surgery, and is equipped with very extensive Laboratories and all other necessary appliances for Practical Teaching. Ample facilities are afforded for Clinical Instruction at the Royal Infirmary, Maternity Hospital, Royal Hospital for Sick Children, Hospital for Infectious Diseases, and Royal Asylum for the Insane. Four Degrees in Medicine and Surgery are conferred by the University, viz.: Bachelor of Medicine (M.B.), Bachelor of Surgery (Ch.B.), Doctor of Medicine (M.D.), and Master of Surgery (Ch.M.), and these Degrees qualify for practice throughout His Majesty's Dominions, and for admission to the Naval, Military, and other Public Medical Services in the United Kingdom. A DIPLOMA IN TROPICAL MEDICINE AND HYGIENE (D.T.M. & H.) is conferred on Graduates in Medicine of the University, and specially approved Medical Practitioners who have resided abroad. There are also DIPLOMAS in PUBLIC HEALTH (D.P.H.) and in PSYCHIATRY (Dipl. Psych.). In MUSIC there is a full course of study for graduation, and the Degrees of Mus.B. and Mus.D. are conferred.

The University Staff consists of 50 Professors, over 90 Lecturers, and about 60 Assistants and Demonstrators. The annual amount available for Fellowships, Scholarships, Bursaries, Prizes, &c., is over £21,000. Facilities are afforded for research in scientific and other subjects.

Women may attend the Classes in all the Faculties, and they are admitted to graduation in Arts, Science, Law, Medicine, and Music.

Information regarding Matriculation, the Curricula of Study for Degrees, &c., the Examinations for Fellowships, Scholarships, &c., may be obtained from the Deans of the Faculties, or from the Clerk of Senatus; and full details are given in the University Calendar, published by Mr. James Thin, 55 South Bridge, Edinburgh—price 5s. 6d. by post.

The Preliminary and Degree Examination Papers in each of the Faculties are also published by Mr. James Thin, viz.—Preliminary, 1s.; Arts Bursaries, 6d.; Degree Papers—Arts, 1s.; Science, 1s.; Divinity, Law, and Medicine, 6d. each; Music, 3d.

By Order of the Senatus,
1920. WILLIAM WILSON, Secretary.

ISLE OF ELY EDUCATION COMMITTEE.

The Horticultural Education Sub-Committee invite applications for the post of HORTICULTURAL ADVISER and SUPERINTENDENT for the administrative County of the Isle of Ely. Candidates must have good educational qualifications, with suitable scientific and technical training received at a horticultural or agricultural college. Salary £300 per annum, with an allowance for travelling expenses.

Applications, accompanied by copies of not more than three recent testimonials, to be sent before April 8 prox. to the Education Secretary, County Hall, March, from whom further particulars of the duties of the appointment may be obtained.

March 22, 1920.

THURSDAY, MARCH 25, 1920.

Knowledge and Power.

TO-DAY, in almost every sphere of activity, as is widely recognised, the majority of the important problems that have to be handled are largely technical in character; this is so whether these problems lie in the broad domain of national policy, in the narrower limits of administrative action, or in the restricted fields of executive performance. To this situation is due, as is well known, the need that has arisen in recent times for that high degree of specialisation in certain kinds of knowledge which has revolutionised the scheme of organisation of the *personnel* in the fields of commerce and industry, and is likewise responsible for the introduction, in many enterprises throughout the world, of the *régime* of the expert.

Being, comparatively speaking, a newcomer in the realms of officialdom, the modern technical expert has still to be assigned his place of precedence there, and at the same time to have the scope of his authority and the dignity of his status definitely determined and unequivocably declared. These are matters calling for early attention, for a suspicion exists, not without foundation, that, whilst in commercial and industrial circles the expert has been very generally permitted to occupy a position of influence compatible with the importance of his *métier*, in the governmental sphere the expert has, more often than not, been relegated to a position in which his every purpose is rendered more or less ineffectual, one, moreover, in which the exercise of his legitimate activities is barely tolerated by those occupying the clerical or controlling positions.

During the past few years the prevailing uneasiness regarding the unsatisfactory footing on which the technical staff in the public services finds itself has been quickened, owing largely to an appreciation on the part of the public of the fact that it was the failure in governmental quarters to give heed to the advice of the technical expert that was responsible for bringing the country to the brink of a dire catastrophe—one, indeed, which, at the crisis of the late war, threatened its continued existence as an independent people, one from which it escaped with but a very narrow margin.

The British public had been persuaded to believe that any deficiency in the military establishments of the country was more than counterbalanced and compensated for by reason of the high perfection to which every detail connected with the Royal Navy had been brought. In the circumstances, the public may well be pardoned for the belief so firmly held by it before the Great War that the British Navy had nothing whatever to learn from either friend or foe.

That the popular conceptions on the foregoing matters were in many respects erroneous now stands out in cold print in the pages of Lord Jellicoe's "The Grand Fleet, 1914–16."[1] In the preface to this book it is stated in unequivocal terms that the Germans were "superior to us in material." The gallant Admiral does not limit himself to generalisations, but on many a page he particularises the specific matters in which the equipment or arrangements on our battleships were deficient, defective, or obsolete, and our defence works wanting. For example, he states: "The Jutland battle convinced us that our armour-piercing shell was inferior in its penetrative power to that used by the Germans." "Some delay occurred in improving our range-finders. . . . Our most modern ships were provided with range-finders 15 ft. in length, but the majority of the ships were fitted with instruments only 9 ft. long. During 1917 successful steps were taken to supply range-finders up to 25 ft. and 30 ft. in length; a series of experiments with stereoscopic range-finders was also instituted in the same year. It had become known that the Germans used this type of range-finders." "The use of smoke screens was closely investigated as a result of our experience of the German use of this device." "Neither our searchlights nor their control arrangements were at this time of the best type." The foregoing are but a few of the specific matters in which the foremost Navy in the world is recorded to have been outstripped, at a critical period of the war, by a rival of new creation.

In other directions, too, was Great Britain lacking in the matter of naval defence. For example, reference is made by Lord Jellicoe to the fact that harbour defences and obstructions were non-existent in the early days of the war. Again, it is stated that in the matter of gunnery and torpedo practices considerable leeway had to be made good. As regards the former, after the outbreak of war a great extension of the system of director firing, by which one officer or man can

[1] Published by Cassell and Co., Ltd. Price 31s. 6d. net.

lay and fire all the guns of a ship, was made (in August, 1914, only eight battleships had been fitted with this system).

In the face of the disclosures made in connection with the Battle of Jutland, it may well be asked whether the deficiencies and defects to which attention has been directed could have been foreseen in peace time and provided against. Little doubt on the subject can be left in the minds of those who read in a spirit of inquiry "Fifty Years in the Royal Navy," the autobiography of Admiral Sir Percy Scott[2]; the matters dealt with therein provide a direct answer to the foregoing question. In many of the pages of this autobiography will be found the story of the striving, over a long period of years, after progress and efficiency in relation to various details connected with the Senior Service, and of the obstinate opposition to all reforms which was constantly met with by those who were in pursuit of essential improvements. The remarks of Sir Percy Scott on every subject the theme of which relates to the attempt to introduce into the public service some new idea or device, or some improvement on existing apparatus, machinery, or methods, have all the same ring about them. In relation to every one of the matters to which the distinguished Admiral refers, the conduct of those in the controlling positions was consistent; in every instance the advice and assistance of the expert were ignored, either until it was altogether too late, or until considerable harm had been done and the waste of much public money, if not also the loss of valuable lives, involved.

Sir Percy Scott tells us that it was so long ago as February 10, 1909, that battle practice first took place, at Tetuan, with extemporised director firing. Yet it took the Admiralty two years to come to a decision as to its introduction into the Navy, and the Board waited for eight years—indeed, until the nation had for nearly three years been involved in a life-and-death struggle—before it adopted the system generally.

Another remarkable illustration of Admiralty methods mentioned by Sir Percy Scott is that connected with the depth charge, which ultimately turned out to be the antidote to the submarine. The design of a depth charge, actuated by a hydrostatic valve, was submitted by Capt. P. H. Colomb on October 1, 1914. The idea was so simple that these depth charges could have been supplied in large quantities within a few weeks of the date mentioned, but it was not until 1916 that a decision was arrived at on the matter; meanwhile, the delay, it is stated, involved the nation in a loss of 200,000,000*l.*

A similar striking example of officialism occurred in relation to the Pomeroy bullet, which was eventually successfully used in attacking Zeppelins. This bullet had been first tried in 1908, and gave satisfactory results; it was submitted to the War Office in 1914, but rejected. In June, 1915, another trial was made of the bullet, and again it proved satisfactory; however, it was not accepted and brought into use until the autumn of 1916—that is to say, the country had to wait two years for the adoption of an essential missile which was urgently wanted, in spite of the fact that the efficacy of the invention had been unmistakably proved many years previously.

Instances of official ineptitude and bureaucratic formalism similar to those referred to in the foregoing examples, and others mentioned in Sir Percy Scott's autobiography, are, unfortunately, all too common in practically every Government Department in this country, and arise all from the same cause, the ignoring of the advice and opinions of the technical expert and a fixed distrust of him. Expression was given to this attitude a few years ago by an official of the administrative branch of a Government Department during an inquiry before a Select Committee of the House of Commons into an important engineering contract—a contract in which the technical staff had been entirely ignored at every stage connected with its negotiation. "I do not think," said this official, "these gentlemen, the highly technical experts, are suited, by their education or their environment and line of thought, and all that sort of thing, to decide very often what is the best thing to do. They jump to a conclusion." Yet the most superficial examination of the evidence that exists in relation to the measures and steps by which the technical expert has succeeded in providing man with the material comforts enjoyed by him, and by which there have been placed at the command of the business community the powerful aids to commerce and industry comprised in the domain of the public utility services, affords the most complete contradiction of the mischievous doctrine contained in the foregoing utterance.

It must not be imagined that it is alone in relation to questions of high policy, such, for

[2] Published by John Murray. Price 21*s.* net.

example, as the Dardanelles Expedition—with regard to which it is recorded in Lord Fisher's "Memories"[3]: "The Cabinet Council reached its conclusions without drawing the opinion of the expert thereat for its guidance"—that the technical experts are ignored; on the contrary, many examples can be given of instances when, in relation both to important technical aspects of departmental policy and to simple matters of executive detail, the advice of the technicians has been overruled or not sought.

The root cause of the mischief under discussion lies in the system of the Civil Service. A privileged class has been allowed to grow up there, a class which, by reason of its proximity to the Minister and of the long service of the individual members composing it in one particular office, has obtained too great an influence, and is thus enabled to exercise an ascendancy not only over Ministers, who flit through their Departments, but also over those officials whose early years are spent on executive and technical duties.

The remedy for the present unsatisfactory state of affairs as regards the position of the technical expert is not far to seek. As matters stand to-day, the technical staffs in the Government Departments have too little influence and authority, whilst the Civil Service clerk has too much influence and an excess of authority. The disparity between the powers of these two classes is a source of public danger, and the way to obviate it is by a thorough reorganisation of the Civil Service and its system. What is required is that the chief administrative posts shall forthwith cease to be a monopoly of the clerical staffs. A suitable organisation for the Civil Service would be one which provided that entrants into every branch of it should, as a rule, begin their careers in an executive grade, and be promoted to occupy administrative posts at the headquarters of a Ministry or Department only after giving proof that they were familiar with the practical aspects of the matters they might be called on to administer. By the introduction of such an organisation into the Civil Service, it would be possible to select the best qualified officers in each branch for the important administrative posts, and, in consequence, render possible the adoption of a system whereby all matters referred to headquarters on which decisions have to be passed would come invariably before those who were experts in the particular subject upon which action had to be taken.

[3] Published by Hodder and Stoughton. Price 21*s.* net.

Aeronautical Research.

Applied Aerodynamics. By Leonard Bairstow. Pp. xii + 566. (London: Longmans, Green, and Co., 1920.) Price 32*s.* net.

IMPATIENTLY as we have waited for the publication of this book, we feel that its appearance could scarcely have been more opportune. For here, as we believe, will be found abundant evidence in support of those who, like the Committee for Education and Research in Aeronautics, have striven to resist the break-up of our aerodynamics laboratories and design staffs. Research is always costly, aeronautical research superlatively so; and a public whose ear has been somewhat dulled by the insistence with which its claims were urged—not always wisely—during the war is somewhat naturally deafened now, by strident calls for economy, to any temperate statement of its claims. It is not promises that are wanted at the present time, to justify further expenditure, but a record of things achieved; and although the tangible results of British science and invention, as applied to the construction of aircraft, have appealed, and by the glamour of long-distance flying are still appealing, to the popular imagination, yet it has resulted from secrecy necessary in war time that the foundations upon which these successes have been built—the patient, detailed investigations which have supplied our designers with the data they required—are familiar only to a very few, being for the most part contained in reports of which the circulation, no less than the appeal, has been limited to specialists.

Now, within one volume of reasonable dimensions and large type, we are presented with an authoritative review of the work achieved by our research organisations during five years of strenuous activity. We have no fears that impartial judgment will pronounce the time and expenditure to have been wasted. Most branches of applied science have developed rapidly under the stimulus of war conditions, but of applied aerodynamics it might without serious exaggeration be said that the science has been created. The pioneer work is done, but to those who read Mr. Bairstow's book carefully it will be evident that on every side lie fields for research of which scarcely the surface has been broken, and that no mistake could be more disastrous, if we acknowledge the importance of aeronautics, than a refusal now to avail ourselves of the experience acquired by those few men to whom its present state of development is due.

We do not, of course, imply that the book is

merely a record of war developments, still less an apologia for the aerodynamics laboratories. It is, both in intention and in effect, a handbook for the student, for the designer, and for the research worker, which assumes no previous knowledge in the reader, beyond the elements of hydrostatic theory, and illustrates the applications of aerodynamics in all its essential branches. Mr. Bairstow's qualifications for authorship are too well known to need description here. A leader in aerodynamic research at the National Physical Laboratory since the formation of the Advisory Committee for Aeronautics in 1909, his duties as expert adviser to the Air Board and Ministry during the war brought him into intimate contact with every side of aeronautical activity. Of great importance, in our opinion, is the fact that he has had first-hand acquaintance with research on both the model and the full-scale aeroplane, and so is entitled—whether we agree with his conclusions or not—to pronounce with authority upon the vexed questions which relate to "scale effect." But copious knowledge has not always, in the past, given us satisfactory text-books, and it is a real pleasure to find how well balanced is the structural scheme which Mr. Bairstow has devised. After touching lightly, but adequately, upon the early history of his subject, and having illustrated its present state of development by brief descriptions of typical modern aircraft and engines, he passes at once to a discussion of the principles of flight, and in his second chapter, within some fifty pages, the reader learns, by actual examples fully explained, how to make practically all the fundamental calculations required in estimating the performance and characteristics of aircraft.

In our opinion, this is one of the best features of the book. Aerodynamics is an empirical science, and design proceeds by the manipulation of experimental curves which, with rare exceptions, cannot be represented by mathematical functions; present-day developments consist almost entirely in refinement of the experimental data and of the methods of their manipulation, and thus have a tendency to obscure, for the general reader, the basic principles involved. By discarding all refinements, whilst extending his specimen calculations to cover a wide range of problems, Mr. Bairstow emphasises the fundamental principle that all design is conditioned by the experimentally determined properties of the wing section, and thus prepares his reader for an intelligent appreciation of the more detailed considerations which follow.

Chap. iii., which deals with experimental methods of measurement, as they have been developed in the aerodynamics laboratories, is characterised by the same breadth of view and neglect of unnecessary refinement. In it the reader, now initiated into the problems which the science of aerodynamics has to solve, learns how these problems are attacked on the experimental side, and what order of accuracy may reasonably be expected in their solution. The account given on p. 115 of the theory of model experiments on non-rigid airship envelopes might seem to suggest that the model scale should be chosen so as to give (in theory) *equality* of fabric tensions, whereas actually, of course, it is easy to obtain *proportionality* in a model of any scale, and increase in scale has the advantage that it reduces the error introduced by the weight of the fabric. Again, we could have wished that some description had been included of the "cascade" experiment on aerofoils, which seems so promising a line of development for propeller theory; but from a footnote on p. 290 we gather that the technique of this experiment had not been fully worked out at the time of writing.

Considerations of space prevent us from dealing as we could have wished with chap. vii., an admirable *résumé* of the investigations which have been made—without very much result, so far, as regards their practical application—into the theory of fluid motion, and with chap. viii., in which the author states his present position on the question of "scale effect." Not long ago this was a question which divided aeronautical experts into two fiercely warring bands: but the heat of that battle has since died down, and we imagine that few will take exception to Mr. Bairstow's summing up of the position. Scale effect, or at any rate its possibility, is indicated by theory; it is proved beyond question to exist in many of the problems which can be investigated in wind-channels; and it may very well be present to a troublesome degree in many of the problems which concern the complete aircraft: but the order of accuracy hitherto attainable in full-scale work is too far below the ordinary standard of wind-channel work to justify us in attributing to scale effect every discrepancy which has been discovered in the comparison of model and full-scale data.

The remainder of the book, which analyses and applies the design data from the aerodynamics laboratories, scarcely affords suitable material for criticism on a first reading; ultimately these chapters must be judged by the service which they render, in daily use, to the design office and the laboratory. We shall content ourselves by mentioning one particular in which, as we believe, the book could be improved in a second edition. We do not think it is merely

a personal preference which has been disappointed by the scantiness of the references in this volume to original sources of information, and to authors; in our opinion, the more authoritative a book is, the more importance attaches to complete references, whereby the reader is assisted in pursuing his investigations into any particular question which interests him. We hold, too, that the mention of authors' names is important for other reasons than the mere gratification of their personal vanity; it is an aid to memory and to verbal discussion (how otherwise—to take examples at random—shall we attain to the definiteness of meaning which we associate with "Lenz's law," the "Rankine cycle," "Bernoulli's equation," or the "Willan's line"?); and it is of enormous assistance to the reader in helping him to fit each new fact or theory into his mental picture of the scientific structure. We might add that consistency demands either the suppression of all references to individuals (which is no longer thinkable) or the adoption of the course which we advocate: no one would accuse Mr. Bairstow of partiality (and if a refutation of the charge were wanted, it could be found in the entire absence of all reference to his own part in the work which he describes), yet we have been struck by the apparent arbitrariness with which authors' names have been included or suppressed. We are conscious that it would be very difficult to give complete references at the present time, mainly because of the unfortunate preference for anonymous reports which was so prevalent in the early days of the war; but this difficulty should be removed by the publication of the reports in their final form, and we shall hope then to see those additions which will make this book the standard work of reference in its subject.

The printing and paper of the book are good, and a special word of praise is due to the illustrative diagrams, which appear to have been re-drawn specially for this work. The book is thick and rather heavy, and those who will make it a work for daily reference will probably find it desirable to clothe it in rather stronger binding.

Gymnospermic History.

Fossil Plants: A Text-book for Students of Botany and Geology. By Prof. A. C. Seward. Vol. iv.: *Ginkgoales, Coniferales, Gnetales.* (Cambridge Biological Series.) Pp. xvi+543. (Cambridge: At the University Press, 1919.) Price 1 guinea net.

TO every science, works which bring together the data of the subject are essential, and to none more so than to palæobotany, which is based on the correlation of fragmentary remains from all countries and of all ages. Prof. Seward has served his science well in completing the almost Herculean task of writing a text-book covering the whole field of these plant remains. The first volume appeared many years ago, and this, the fourth, is the final one of the series.

This disappointingly closes with the higher Gymnosperms, the series of plant families treated, and the author does not propose to continue the work so as to deal with the flowering plants. This is perhaps scarcely surprising, as the data bearing on the flowering plants are very complex and of a fragmentary and unsatisfactory nature, and have, moreover, been little studied in this country. Some up-to-date handling of the Angiosperms is greatly to be desired, and students will await with some impatience the appearance of the independent work Prof. Seward promises, in which he proposes to deal with the generalities of plant distribution, taking the fossil Angiosperms into account.

Prof. Seward's text-book should be a useful tool, not only to palæobotanists in particular, but also to all students of either botany or geology in general. Somewhat lost sight of in the mass of fossil species, there are, prefacing each group, excellent accounts of the living representatives of each family.

In a volume of such laborious detail as the present one, which appeals to the specialist rather than to the average layman, there must, of course, be many comparative trifles which tend to sidetrack any critic by inducing an attempt to deal with minor controversial matter. To do this, however, in a general review would be both ungenerous and unfair, because the amount of public recognition and the gratitude which scientific authors receive is small and out of proportion to the labour and to the sacrifice involved in their tasks.

Misprints are remarkably few, and the general perspective of presentation is well preserved, although here and there the author has naturally indulged in rather longer descriptions of one or two individual species which are first published in this book than such specimens would be allowed had they been published separately at an earlier date. It is doubtful, as a matter of general policy, whether a text-book is the place to publish new species at all, although any research worker must have in his notes records of small and relatively unimportant species which scarcely deserve independent memoirs, and the temptation to put them in the text-book must be very great.

Knowledge of the higher Gymnosperms largely depends on petrified material of secondary timber, for although fragments of foliage impressions with a few cones are known, they are compara-

tively rare. The Mesozoic and Tertiary rocks, however, are rich in silicified and other petrified woods, many of which belong to the coniferous genera. The determination of these woods is a particularly difficult branch of palæontological research, demanding great patience and knowledge of the finer points of plant structure. Wood determinations are often—indeed generally—neglected, owing to the difficulty of mastering the technique; but, as Prof. Seward truly says, "the student cannot afford to neglect this line of inquiry if he desires to obtain a comprehensive view" of the essentials of palæontological plant history. In the present volume a considerable proportion of the space is allotted to the careful and critical consideration of the species based on secondary wood.

The terminology of this section is not entirely that adopted by other leading workers in this field, but tends perhaps to simpler grouping of the subject by the elimination of certain "genera" which are based on distinctions too subtle for secure determination, such, for instance, as the Phyllocladoxylon of Gothan. The elimination of doubtful genera, principally those which have names suggestive of affinities remote from those with which they properly are really to be associated, on the whole tends towards the clarifying of the science.

In conclusion, one can only urge every geologist and every botanist not only to possess himself of Prof. Seward's text-book, but also to acquaint himself with its contents.

The Nature of Musical Sound.

The Foundations of Music. By Dr. Henry J. Watt. Pp. xvi + 239. (Cambridge: At the University Press, 1919.) Price 18*s.* net.

THE author unfolds a new theory to account for the fact that certain combinations of sound, called concords, are "pleasant," while others, called discords, are "unpleasant." In place of the ancient theory by which the "harmony of numbers" in the sense of proportions of string-length to pitch has dominated these questions since the days of Pythagoras, he considers that sound possesses "volume," an attribute somewhat difficult to grasp at first sight. So far as we can understand the new theory, the volume of a low sound contains within itself the volumes of all sounds higher than itself; the proportions of the various volumes coincide with the well-known proportions of those of pitch. Hence the volume of the sound represented by C is exactly double that of the next C above it, and the volume of G, lying between the two, is two-thirds that of the lower C.

As the lesser volume is contained in the greater, there is "fusion" of volume when two sounds are heard together. This fusion being complete in the octave, the two sounds coalesce to such an extent as sometimes to be heard as one sound. We are to understand, then (so far as we can make out), that the octave is the "pleasantest" interval. Next come fifths and thirds as pleasant intervals; and the discords, the volumes of which do not fuse with the root volume, are classified as "unpleasant" (pp. 24 *et seq.*), or words to that effect. We confess that this theory is so novel that we find it hard to grasp. To the musician a discord is not an "unpleasant" part of his raw material; it is simply a chord that requires to be "resolved" into a succeeding chord. It has, therefore, the element of motion, while the concord suggests repose.

The theory of fusion raises the ancient question of the prohibition of consecutive fifths and octaves. The author discusses at great length all the well-known attempts at explanation, and adds his own. Probably the prohibitions are merely conventions, as suggested by Cyril Scott, quoted in a footnote on p. 132. In the tenth century Hucbald says of the ancient organum of his day: "If sung with suitable slowness, you will see that it produces a sweet concord." The present reviewer, wishing to scoff at the notion that successions of fifths and octaves could "produce a sweet concord," asked the choir of the Plainsong Society to sing a specimen of tenth-century organum. To his and their surprise they found Hucbald entirely vindicated. And Dr. Watt shows (p. 84) that Gevaert, making a similar experiment at Ghent in 1871, found exactly the same result: "The impression made on the audience was profound."

The only example Dr. Watt gives in musical notation (p. 120) is a series of consecutive fifths by Karg-Elert, played very slowly on the softest organ stop. He offers an explanation of its "beauty"; we think, however, that the same passage, if sung or played rapidly and loudly, would be anything but beautiful.

Dr. Watt revives the old controversy as to whether the interval of the fourth is a concord or discord. We thought that musicians had long settled that the fourth from the bass, since it requires resolution, is a discord, while the fourth from any other voice is a concord, since it does not require to move.

The book ends with chapters on "The Objectivity of Beauty" and "Æsthetics as a Pure Science." To those wishing to investigate the nature of sound, its new outlook should prove interesting.

Science of Food.

(1) *Bacteriology and Mycology of Foods.* By Dr. Fred Wilbur Tanner. Pp. vi + 592 + 10 plates. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1919.) Price 28*s.* net.

(2) *Food: Its Composition and Preparation. A Text-book for Classes in Household Science.* By Mary T. Dowd and Jean D. Jameson. (The Wiley Technical Series.) Pp. viii + 173. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1918.) Price 6*s.* net.

THESE two books are very laudable attempts by our American cousins to place the important question of food on a scientific basis. The war brought home to people at large the importance of such study, but one hopes, in days of peace, not only that investigations will continue, but also that their application will be carried out to a greater extent.

(1) The first of the two books mentioned above is very complete, not only in the number of important foods dealt with, but also in the numerous methods of investigation described to detect impurities and prevent contamination with undesirable admixtures. It is the science of cleanliness in technical costume. The preface informs us that the work is written for those who wish to fit themselves for food control; but as it presupposes a thorough training in bacteriology and chemistry, we fear it will scarcely appeal to those who are food controllers here. What is really wanted is a book that he who runs may read, a book intelligible to the manufacturer, the packer, the tradesman, and the housewife. To present such with the graphic formulæ of, say, amino-acids and fats would be simply to terrify them. Still, the book should be useful to a more limited section of the population —namely, the analysts and bacteriologists. Its price strikes one as exorbitant even in these days of high charges.

(2) The second book is of a much more practical nature, and will be welcomed by all those engaged in the study of household science. It is an excellent chemical introduction to the science of intelligent cookery. The authors have taken care to provide themselves with a good preliminary knowledge of physiology and bio-chemistry, and if they go a little wrong in a few details, such as in their account of the vitamines, the slips are trivial, and do not affect their main arguments or their main endeavour, which is to rescue cookery from the domain of empiricism and ignorance.

W. D. H.

Our Bookshelf.

Petrology for Students: An Introduction to the Study of Rocks under the Microscope. By Dr. Alfred Harker. Fifth edition, revised. (Cambridge Geological Series.) Pp. viii + 309. (Cambridge: At the University Press, 1919.) Price 8*s.* 6*d.* net.

A HEARTY welcome must be extended to this new edition of one of our most widely known geological text-books, which has had considerable influence in securing systematic and accurate descriptions of rocks by British petrologists. The present edition contains a few pages less than the previous issue, but this has been accomplished by diminishing the space at the headings of chapters and by the excision of superfluous notes and references to occurrences of minor interest, so that the value of the book is in no way diminished. New illustrations have been added, and the chapters on metamorphism largely re-written.

As in previous editions, the author rejects names given unnecessarily to local varieties, which he distinguishes simply by reference to the places from which the names were formed. This process might with advantage have been carried very much further. There is, however, already so much diversity in petrological nomenclature, not only in different countries, but also among individual geologists, that the author is probably wise in refraining from attempting any far-reaching reforms.

Perhaps in another edition a certain number of analyses of the more important rock-species might be included, as well as their specific gravities, which afford a valuable means of checking the determination of rocks in the field. J. W. E.

Chemistry and its Mysteries: The Story of What Things are Made Of, Told in Simple Language. By Charles R. Gibson. (Science for Children.) Pp. 246. (London: Seeley, Service, and Co., Ltd., 1920.) Price 4*s.* 6*d.* net.

HERE is another of Mr. Gibson's wonderful books for children. This time Mr. Gibson treats of the elements of chemistry, the conception of chemical constitution, combustion and respiration, electrolysis, spectroscopy, and "queer things" such as radium and liquid air. The author has not lost his powers of stating scientific propositions in simple and attractive form without departing (except in quite minor details) from the strictest accuracy. We confess that we had thought modern children rather more sophisticated and apt to regard as ridiculous analogies drawn from nursery games; but in this matter we bow to Mr. Gibson's judgment. His success in what he has set himself to do is beyond question; criticism, if any were offered, would concern rather his objects. But this is not the place to inquire whether it is really useful, or even harmless, to present the complex and highly theoretical conclusions of modern science without any serious attempt to present also the evidence on which they are based.

Neue Beobachtungen über den Erreger der Maulund Klauenseuche: Die Entwicklung des Schmarotzers im Blut, speziell in den roten Blutkörperchen. By Dr. Hrch. Stauffacher. Pp. 62+plates. (Zürich, 1918.) Price 8 francs.

THE author describes and illustrates a number of curious linear and spherical bodies found in the red corpuscles of animals with foot-and-mouth disease, and works out a life-history for them along the lines familiar from the parasites of malaria. The difficulty in all such investigations is to be sure that the intracellular appearances represent the cause rather than the effect of the disease, and to distinguish between a parasite and some remnant of the nucleus of the erythroblast seems often to be impossible. Sometimes the nuclear remains are plain as such; sometimes by special methods they can be brought to take a basic stain in cells which by ordinary procedures would appear normal; it is quite possible that they may be thus unmasked in consequence of a parasitic illness. What curious objects may be found in red corpuscles is readily appreciated by examining the blood of a dormouse or of a new-born rat. The nail- or tadpole-like bodies shown very clearly in the first photograph are extraordinarily similar to those demonstrated some years ago by Braddon in (or on) the red cells in rinderpest.

A Night Raid into Space: The Story of the Heavens told in Simple Words. By Col. J. S. F. Mackenzie. Pp. 143. (London: Henry Hardingham, n.d.) Price 2*s.* 6*d.* net.

THIS book describes in a chatty, discursive way the elementary facts of astronomy. It is avowedly written for those who have absolutely no mathematical knowledge. Unfortunately, there is in many places an absence of the necessary precision of statement. Thus the description of precession suggests that it affects the earth's orbital motion, there being no mention of the equatorial plane. Moreover, the action is ascribed wholly to the sun, though the moon's contribution is twice as great. The description of sidereal time, and the explanation of the spectroscopic determination of radial velocity, are misleading. Also the erroneous statement is made that the Babylonian year contained 360 days, and had an intercalary month every sixth year. Its real length was 12 lunations, or 354 days, and there were 7 intercalary months in 19 years. Altogether the book needs careful revision; if this were carried out, it could be recommended as a simple handbook.

Musings of an Idle Man. By Sir R. H. Firth. Pp. xii+359. (London: John Bale, Sons, and Danielsson, Ltd., 1919.) Price 7*s.* 6*d.* net.

THIS book comprises seventy-five readable and suggestive essays on the most varied subjects, ranging from "The Origin of Life" to "Good and Bad Form." In an essay on "The End of Life" the author envisages the final destruction of life by heat due to radio-activity.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Museums and the State.

THE old danger arising from the haphazard application of a name surrounds the public institutions which are called "museums." By a perversion of its ancient signification, the word "museum" is now used to designate a collection of natural history specimens, pictures, antiquities, machinery, waxwork or other articles (rarely libraries), as well as the building where it is exhibited to the public either with or without charge for admission. There are various so-called "museums" supported by public funds, either national or municipal. The proposal to create a new body of Government clerks (or to aggrandise an existing one) on the pretence that museums form a "genus" which all alike require central control of one and the same "tape and sealing-wax" type, and that the well-known ignorant, and therefore impartial, Civil Servant is to have new fields of plunder thrown open to him—as "administrator"—is not surprising. We are familiar with such schemes, but, none the less, this is one that all serious lovers of science and of art should resist to the uttermost! What is needed in regard to our existing national and other public museums is not the creation of highly paid posts for otherwise unemployable "administrators," but definite legislation after inquiry and report by a Royal Commission as to the specific purpose, scope, and method of work to be followed in each of those great museums which in this country receive support from public funds. "Overlapping" of collections and neglect of this and that department could be at once prevented by assigning to each museum its proper function and by making its income depend upon its doing what it is intended that it shall do. No central salaried body, no "committees" of delegates, trustees, or members of governing bodies are required. They certainly would prove incapable and obstructive, as such "committees" have generally shown themselves to be.

The defects in the working of our national museums have arisen from the fact that they have come into existence in obscure, surreptitious ways and by chance—witness the history of the British Museum, of the Victoria and Albert Museum, and of the new so-called Science Museum. They have no programme, no clear assignment of scope and purpose to guide them, and no attempt is made by successive Governments to define their functions and to ensure for each of them and for other "museums" supported by public funds a reasonable system of management and control designed so as to ensure their activity and development as efficient instruments of public service.

A central bureau of managing clerks pretending to deal under a heterogeneous "committee" with all the various branches of science and art concerned in the life and progress of all our museums would be an exaggeration of the worst features of the present management by irresponsible and incapable "trustees."

I am convinced that what is needed is the separation and independence of the chief departments now agglomerated in the national museums and their redistribution to form a series of independent institutions each under its own highly expert specialist as director, with no other interference than that of a visitatorial board assigned to each museum, approved

by the Government, and reporting annually on the work and requirements of its own particular museum. Such an institution is Greenwich Observatory. Limiting my suggestions to the natural history sciences, I would have a separate "museum" for zoology and animal palæontology; another for geology (the study of the history of the earth's crust, *not* merely palæontology) with mineralogy and petrology, uniting the museum of the Geological Survey with certain portions of the British Museum; another for botany formed by the removal to the great and flourishing establishment at Kew of the botanical department of the British Museum; and another for anthropology and human palæontology. There seems to me no reason, no advantage, in mixing up the administration of these great centres of special study and research with one another or with the museum of ancient art, or for associating any of these with the great national public library.

Our museums are liable to suffer from the erroneous notion that their *chief* purpose is to furnish ready instruction to school-children and "the general public." Speaking with special reference to natural history, I think it will be admitted that (as in the case of precious records, antiquities, books, etc.) the main and most important function of a museum is the acquisition, study, and safe and permanent guardianship of specimens—specimens which are often unique or of extreme rarity and value, and form the actual evidential basis of the natural history sciences. This guardianship is necessarily to be associated with perennial study and development of the collections and abundant publication of finely illustrated monographs, catalogues, and descriptions by the museum director and his staff. These duties are, in spite of obstacles, performed in a highly creditable way by the present staff of the Natural History Museum, which, were it free from the dead-weight of an unsympathetic and irresponsible committee of trustees, would render even more abundant services to science and the nation.

In my judgment, the exhibition of the collections in galleries, through which the public may promenade or be personally conducted by itinerant lecturers, is a matter of *subordinate* importance. But it is one of great value to the public, and must be seriously taken in hand and dealt with wisely by the director of each museum. It is the simple fact that many (but not all) of the fine things in museums of natural history can readily be exhibited to the public so as to give pleasure and instruction, and it is desirable to enlist the sympathy and interest of the public by exhibiting with the greatest skill and judgment specimens so displayed and labelled as readily to attract attention and convey information suited to those who have no special knowledge of the branch of science in which the specimens have their place.

It is, however, of the utmost consequence that this kind of exhibition should be strictly limited in amount, and that what is done in the way of such exhibition should be the very best possible—the specimens most carefully chosen because they can be well seen and appreciated when in a glass case and without being handled, and because the information which they and others placed with them afford is of first-rate importance or of a specially fascinating character. It is a profound mistake to attempt to set out the mass of the contents of a museum in this way. Neither space nor skilful design and handiwork can be afforded for "exhibiting" huge collections in this style. The public is wearied and confused by too great profusion, and galleries which are needed for the preservation and study of collections by experts are liable to be sacrificed to the satisfaction of a mistaken demand for the setting out of a sort of high-class Noah's Ark through which a visitor may wander in a state of dreamy contentment, hypnotised by the endless stream of queer or brilliant things appearing and disappearing before him without any effort or comprehension on his part!

In any case, it is, I think, important not to allow the great public museums to become class-rooms for ill-provided schools. I should like to see the system which is used in the American Museum of Natural History in New York introduced. There is a large lecture-room in the museum, and courses of lectures on the contents of the museum, illustrated by photographic lantern-slides, are given by highly qualified members of the museum staff. Copies of the lectures and the lantern-slides are also supplied by the museum to schools around New York, so that pupils can be prepared by them beforehand for recurring visits to the museum. Though the specimens in a museum may be very thoroughly and well labelled, as in Cromwell Road, it is the fact that no method of insisting upon attention to a label has yet been devised. The public seem to be scared by labels. Nothing is so certain to secure attention as a man standing up in front of the visitor and telling him all about a specimen whilst pointing to this or that part of it.

The Natural History Museum has more of its collections in quiet study-rooms and less of them paraded in bewildering rows in show-cases than has any other public museum in Europe, so far as I know. But it has, nevertheless (in my opinion), too many galleries and cases given up to public exhibition. Even now (after the heroic efforts of Sir William Flower, in whose footsteps I followed in this matter) many of the cases are overcrowded and many are hopelessly placed as regards lighting, and should be abandoned as public show-cases.

There appears to have been no attempt on the part of the architect of the Cromwell Road museum to erect a building with the lighting or height and shape of galleries necessary for such a museum. The trustees were neither consulted in the matter nor competent to give an opinion if they had been.

I should wish, in conclusion, to refer any readers of NATURE who may wish to see a little fuller statement of my opinions concerning the scope and methods of "museums" to the chapter on museums in my "Science from an Easy Chair," second series, 1913, pp. 310–29. E. RAY LANKESTER.

I CORDIALLY welcome the suggestion in the leading article in NATURE of March 11 that the Natural History and other science museums should be placed under the Department of Scientific and Industrial Research. For this Department to take over the Natural History Museum, the Science Museum, the Museum of Practical Geology (and the Geological Survey), and Kew Gardens there need be no change in its constitution. No Royal Commission need be invoked, for the Department would be merely undertaking duties for which it was formed, these institutions being the depositories of most of the basal collections, the facts, upon which much of science is founded. The administration of all could be carried out under one scheme, since the work of all is akin, and the men required to recruit their staffs are drawn from the same class of university men, having similar early training, with diverse specialisations later on.

The present condition in the above museums is most unsatisfactory in respect to differences in the pay and position of their staffs. Thus, according to Whitaker, the assistants at Kew and in the Science Museum start at 300*l.* a year, while geologists and naturalists with similar training start in the two others at 150*l.*; all have war bonuses at present. At Kew there are

eleven in the lower grade (300*l.*–500*l.*) and three above; in the Science Museum the numbers are three and six; and in the Geological Survey twenty and ten. In the Natural History Museum there are thirty-two graded up to 500*l.* a year as against eight above. The position in the latter is so bad that there has been a constant leakage for many years from its highly specialised staff into university and other appointments, the salaries in which exceed those paid in the museum. There is no abundant field of men with private incomes and natural history tastes upon which to draw. The fact that only about one man in four or five who join the staff can hope ever to receive an income above 500*l.* a year prevents any of the best students of universities from entering, while the museum, as the basal institute of several sciences in this country, demands the services of the best men, and of the best men only. The Natural History Museum is, furthermore, out of date in that, while the sciences it represents have advanced, it has taken little account of these advances; its staff has all the same duties as it had twenty or thirty years ago, and, still numbering the same, can undertake new duties only by neglecting older ones. It was never intended to be a museum solely for education and amusement, but the policy pursued in regard to it in the last twenty years has neglected its other sides in respect to research, and its assistants have become more and more the cataloguers, arrangers, and cleaners-up of specimens. The staff less and less takes part in the proceedings of scientific societies because it cannot afford to belong to them.

May I suggest that the pay, position, and grading of the staffs in all the above four institutions should be those of the Home Civil Service, and that the numbers in different grades should be the same as in that Service? The prestige and position of the Civil Service are such that it is an object of ambition to the boy, and no lower position will attract the picked students of science. J. STANLEY GARDINER.

Zoological Laboratory, Cambridge March 15.

THE timely leading article which appeared in NATURE of March 11 raises the very important question of the future administration of the national museums and art galleries of this country. With the main recommendations of the article I am in complete agreement. There is little doubt that the administration of the national museums and art galleries on federal lines from a central Government Department would make for greater efficiency and economy, obviate considerable overlapping, and lead to the fuller use and development of the unique collections housed within their walls. The Department of Scientific and Industrial Research has already assumed control of the Museum of Practical Geology, and the machinery, therefore, for the administration of the whole of our national museums is already in existence, and only requires adapting and expanding.

Such a central Museum Department could be of the greatest service to the provincial museums and art galleries of the country if extended to include them and link them all up in one comprehensive scheme. At present the provincial museums are isolated. There is a lack of co-ordination and co-operation in their work, and they need the advice and assistance of a central body to help them in their development. The national museums between them cover the whole field of museum activities, and their amalgamation into a federal scheme would provide a Department able to deal with any branch of museum work, and to render invaluable assistance to the provincial and private museums throughout the country.

The National Gallery and the Tate Gallery would supply the nucleus for fine arts, the British Museum (Bloomsbury) for pre-history, anthropology, antiquities, and numismatics, the British Museum (Natural History) for natural history, the Victoria and Albert Museum for industrial and applied art, and the Imperial Science Museum for applied and technological science.

It is sufficient to indicate one or two ways in which the assistance of such a Department would be of the highest value:

(1) In the development of a comprehensive system of circulating collections for all branches on the same lines as is now done for industrial art by the Victoria and Albert Museum. (2) The provision of a staff of experts in all branches who could be placed at the service of museums for specialist work on collections. (3) The provision and circulation of approved casts of important and rare specimens. (4) The standardisation of museum cases and fittings to allow of their production on a cheaper and more efficient scale.

A Department such as I have indicated, linking up all the museums into one comprehensive scheme, would lead to the co-ordination of museum work throughout the country. The resources of the museums for each and every available line of research would be accurately known. The provincial and private museums would benefit enormously by having their collections accurately identified and labelled, and be able to utilise and develop their collections to the best advantage. By means of the circulating collections the vast resources of duplicate and reserve material in the national museums would be rendered available and accessible to the nation at large.

The cost of such a scheme would not necessitate an undue burden being placed on the State.

(1) The Government museums are already provided for by direct appropriations. The extension of their work on the lines I have indicated would necessitate larger staffs, but the labours of each expert would not then be rigidly confined to the one museum to which he was primarily attached. While the plan would require organisation and co-operation, it does not seem to involve any drastic change in the present management or governance of such museums.

(2) The public museums of the country could remain, as at present, under the control of the local governing bodies, and their financial resources be provided, as now, by the levy of a rate.

(3) Private museums would need financial assistance from the State, and this might be given in the form of grants-in-aid based on the amount of money provided by the resources of such museums.

The institution of a central Government Department would naturally necessitate Government control and inspection of museums, but such control, wisely and judiciously exercised, would stimulate their development. The Department should clearly recognise that its function would be to help and advise museums, not to hinder them by the imposition of irksome regulations. Museums should be encouraged to preserve their individuality and to develop along their own lines.

It is, perhaps, scarcely necessary to add that a central Department should have as its chief executive officers men trained in the various branches of museum work, whose very training and experience would give them the necessary knowledge to deal sympathetically with questions of museum administration, and to foster that spirit of research which is fundamental to the proper development of museums. W. M. TATTERSALL.

The Museum, The University, Manchester.

Organisation of Scientific Work.

I HAVE not read the report of Sir Thomas Holland's Commission which has led to a discussion in the columns of NATURE, and I do not wish to express an opinion on its conclusions. Those who know something of the conditions of India and of the many economic problems awaiting attack will at least agree that the country offers a great field for the investigator, and a difficult one from the point of view of those engaged in the administration of funds for research.

My purpose in writing is to support Dr. Russell's views on the importance of team-work in scientific investigations (NATURE, March 4, p. 7). It seems to me that in discussing the proper relation of the State to scientific work our conclusions will depend chiefly on the precise meaning which we attach to "research."

Prof. Bateson writes (*ibid.*, p. 6): "Research, like art, literature, and all the higher products of human thought, grows only in an atmosphere of freedom." But should not the word used here be "science"? Is not "research" the art by which knowledge is advanced? And is it not the case that in this art there is need for the co-operation of men differently endowed? "Bricklayers" may be wanted as well as "architects" in the building up of knowledge, nor are delays in programmes, other than housing, necessarily due to the lack of a plan.

If by "research worker" one meant only the "master," then I should agree with Sir Ronald Ross (*ibid.*, p. 6) that the policy of organising institutes for scientific research and institutes for the writing of poetry might be considered together. But research workers are not all "masters." There are other grades essential to progress in certain branches of knowledge, never likely to make great discoveries, perhaps, but, since the State needs them, it must enable them to live; and it is the function of the "official" not to direct their work (that must be left to the "master"), but to see that they live under conditions likely to promote efficiency. I am not sure that I agree with Prof. Bateson. There may be danger in State action, but it seems to me to be safer than inaction.

While arguing for the recognition of the importance of co-operation in research, let me add that, whatever part the worker in a research laboratory may be called upon to fill, it is essential that he should recognise clearly that he is part of a team for the advancement of knowledge, and that he should regard himself as a potential discoverer. I welcome Dr. Russell's analysis of the functions of the staff of an institution maintained for research, as it brings out what seems to me a fundamental point in this discussion, but I feel sure that he would agree with me in deprecating any rigid classification of workers as tending to cause discouragement. Whatever the natural qualifications of the members of a team of workers may be, two are essential for real progress: the desire to learn more and the willingness to help others.

T. H. MIDDLETON.

6A Dean's Yard, Westminster, S.W.1,
March 19.

Science and the New Army.

YOUR leading article of March 18 on "Science and the New Army" directs attention to some hopeful features in our future military organisation, but many will share with you the doubt whether any real fundamental reform has yet been effected. The new policy of "farming out" research work to civil institutions sounds suspiciously like the old policy, so well practised in the past, of getting technical work done and advice given without the obligation of paying anything for it. Doubtless it may be argued that so long as scientific men are complaisant enough to work for nothing a Government Department which paid them would be guilty of extravagance. Ultimately, however, it will be found good policy and sound economy to recognise that skilled knowledge is worth its hire, and scientific men, in their turn, may perhaps learn that in attaching a low valuation to their own labour they help to confirm the widely held idea that expert training is a thing of small account. The Army would keep more closely in touch with all scientific progress in any remote degree affecting the conduct of warfare—and who can set limits to this qualification?—if it retained men of proved competence with the duty of posting the General Staff in all such advances of knowledge. These men need not, in fact should not, give their whole time to the work; it would be an essential condition that they should be in full activity as researchers, teachers, or professional engineers, chemists, etc., and it would be equally essential that they should be remunerated at adequate rates. No unpaid committee, however august the membership, will fill the want.

I must confess that I scarcely understand what is ment by "preliminary design of apparatus," stated to be part of the functions of the military institutions. Of what value is a preliminary design if the underlying principles are not understood, and wherein does it differ from a mere statement of what some uninstructed amateur thinks can be done by "electricity" or by "cog-wheels"? Furthermore, unless these military institutions are directed by trained specialists, the "applied researches" entrusted to them are not likely to be crowned with any conspicuous measure of success.

E. H. HILLS.

Cotton-growing in the British Empire.

IN NATURE of February 26 Sir George Watt reviews in a critical spirit the report to the Board of Trade of the Empire Cotton-Growing Committee. Much of his criticism is based on an expressed aversion to committees, which has misled him into stating that we propose our central (cotton-growing) research institution should be staffed by a "committee of voluntary workers." This is quite erroneous. The report itself describes in some detail the permanent staff which is suggested.

Some of the criticisms are due to the reviewer not having realised that the Committee was dealing with cotton-growing alone, and that the British Cotton Industry Research Association is working in co-operation with the Empire Cotton-Growing Committee through a joint body (of which I happen to be chairman), so that his desire for the Cotton-Growing Committee to establish its central research institution in Manchester, where no cotton will grow, is invalid.

Nor do I think that his suggestion of a programme for the members of the research institution as being "research, education, and cotton production" makes a sufficiently clear discrimination between means and ends; but chiefly I regret that the reviewer has missed our main thesis, which concerns the need for knowledge, based on pure science, as the essential to progress in this matter. Indeed, he seems to be completely antagonistic to this view of ours when he states that "general principles of education must never be allowed to take the place of specific training and definite results." It is no little thing that a utilitarian body, representing all aspects of the cotton trade, from the native cultivators to spinners and manufacturers, should have come into the open with such a plea for the encouragement of pure science, as being the basis of useful development, and it is indeed un-

expected to find this plea condemned by a reviewer in the columns of NATURE.

Nevertheless, Sir George Watt makes a legitimate criticism when he says that our proposals "do not seem to resolve themselves into the promulgation of a concrete scheme of increased and improved production." I would like to explain why we deliberately avoided advancing such a scheme in this report.

The consideration of actual steps to be taken in cotton production is the next stage in the Committee's work, to which it has already settled down. When this report was issued we were penniless, and could not with any utility consider how money should be spent until we were assured of:—(*a*) Annual financial support from Lancashire. (*b*) Regular financial support from H.M. Government. (*c*) Approval of policy from the Governments of the Dominions, Colonies, and Protectorates.

Since our report was issued (*a*) the home industry has agreed to make a voluntary annual levy on itself; (*b*) our maintenance charges are assured, so that our executive can be built up, while the question of further support is under consideration; and official information as to (*c*) is awaited. A large income is already in sight, and the way is becoming clear for practical planning and guidance as distinguished from the enunciation of principles. It should be noted that the capital required actually to grow the cotton which this country now purchases outside the Empire is of the order of 250,000,000*l*., being more than a thousandfold the sum asked for in our report.

But those principles had to be settled first, and I for one regret that Sir George Watt should have missed their significance through misunderstanding the present stage of our development and our inability to be anything else hitherto but a "committee," if we were to represent the native peoples abroad as well as the operatives at home, with all the intervening stages of industry, of administration, and of knowledge.

W. LAWRENCE BALLS.

Edale, Derbyshire, March 8.

I AM obliged for the opportunity given me to read Dr. Lawrence Balls's reply to my review in NATURE of February 26 of the report issued by the Committee on Cotton-Growing, within the British Empire, appointed by the Board of Trade. Dr. Balls seems to me, in the main, to admit my contention, namely, that the Committee's report, as it stands, does not resolve itself into a concrete scheme of increased and improved production of cotton. In fact, it may be said to be unfortunate that the Committee did not anticipate such criticisms as mine by giving the public some hint of the possible future stages of its operations. The public were anxiously awaiting a full scheme, and one that would give distinct prospect of success, but in place of getting such we are now told we have only seen (as it were) the first instalment, and must look for better results in the future.

But, turning to some of Dr. Balls's observations on my review, I do not find that I have stated that the report contemplates the staffing of the central research institution by committees of voluntary workers. It is surely self-evident that there would have to be permanent officials appointed to the central research institution, as also to the branch institutions. But what I did object to was that these officials should be put under a panorama of six committees, as seemed contemplated by the authors of the report. I am old enough to recollect the great Cotton Commission in India. Indeed, my official connection with that country might be said to have commenced with having to try to pick up the dishevelled threads of that futile expenditure of public money. The late Mr. C. B. Clarke, in the preface to his edition of Roxburgh's "Flora of India," alludes to the issue of one of the Commission's reports as follows:—"We have had plenty of Government and other reports, some very large and expensive ones, it is true, but we have very little economic work by persons competent as botanists; and with reference to one large and expensive report lately issued on an Indian economic plant it was discovered after it was printed that the Commission never learnt what the plant was."

The result of the great Cotton Commission of India was officialism, Cotton Frauds Acts, and other such futilities. It is the knowledge of past failures having very largely proceeded from officialism that makes me urge with all the earnestness I possess that the staff of the central and branch research institutions should be as free and independent as the professors of a university. They need no supervision more than is exercised by Departmental control in the allocation of funds and in the laying down of general rules and political instructions. Official control should be with the principal or principals of the college or colleges of cotton, but with no one else.

I am at a loss to understand Dr. Balls when he says I have missed "our main thesis, concerning the need for knowledge, based on pure science, as the essential to progress in this matter." The Committee, as I understood the report, recommends that certain universities should be asked to establish lectureships and readerships; my scheme was that the research institution or institutions, in addition to conducting research, should undertake the entire education of both the experts and the practical planters, and thus have their own professors of plant physiology, plant genetics, mycology, entomology, and the like.

My recommendation is thus to concentrate all effort in the hands of a body of highly trained scientific and practical experts, to place all the funds available in their hands, and to hold them responsible not only to increase the supply, but also to improve the quality of the cotton produced within the British Empire.

GEORGE WATT
(Formerly Reporter on Economic Products with the Government of India).

Annandale House, Lockerbie, March 13.

The Separation of Isotopes.

IN a recent discussion (*Phil. Mag.*, vol. xxxvii., p. 523, 1919) of a number of methods of separating isotopes Prof. Lindemann and Dr. Aston have shown that there is little prospect of effecting by the methods considered a separation which will yield pure samples of the isotopes in a reasonable time. Dr. Aston has recently announced the discovery that chlorine consists of a mixture of at least two isotopes having atomic weights 35 and 37. It appears that there is here a possibility of effecting a separation of the isotopes by a direct method which does not seem to be applicable in the case of most other elements. The method proposed depends on the assumption that in the absorption spectrum of chlorine, which contains a vast number of narrow lines, there is a difference between the wave-lengths of the absorption lines due to molecules containing different isotopes.

Supposing that ordinary chlorine contains the isotopes Cl_{35} and Cl_{37} in the ratio 3 : 1, the molecules will consist of $Cl_{35}Cl_{35}$, $Cl_{35}Cl_{37}$, and $Cl_{37}Cl_{37}$ in the ratio 9 : 6 : 1. It follows that if white light traverses a column of chlorine of such a length that the radiations absorbed by $Cl_{37}Cl_{37}$ are reduced in intensity by a factor $1/10^3$, the corresponding factors in the case of $Cl_{35}Cl_{37}$ and $Cl_{35}Cl_{35}$ will be $1/10^{18}$ and $1/10^{27}$ respec-

tively. Suppose that the light after passing through this column of chlorine enters a vessel containing a mixture of hydrogen and chlorine, which combine under the influence of the light absorbed by the chlorine, it would appear to follow that the initial rates of reaction for the molecules $Cl_{35}Cl_{35}$, $Cl_{37}Cl_{35}$, and $Cl_{37}Cl_{37}$ should be in the ratio $1 : 10^9 : 10^{24}$. The hydrochloric acid thus formed should therefore consist almost entirely of HCl_{37}, if the reaction is allowed to proceed for a suitable time.

If this experiment should prove successful, it would evidently be possible to prepare a "filter" from the chlorine thus obtained which would favour the formation of HCl_{35}. It is fully recognised that there are a number of factors which may affect the success of the experiment, which is now being tried; it is hoped that results will be obtained before long, but the method seems worthy of mention as involving principles which have apparently not been considered hitherto in this connection.

THOMAS R. MERTON.
HAROLD HARTLEY.

Balliol College, Oxford.

Calendar Reform.

VOUS avez cent fois raison de souhaiter un accord pratique entre les partisans de la réforme du calendrier, et je vous demanderai, pour ma part, la permission de répondre quelques mots à votre judicieuse invitation.

On peut lire dans mon Annuaire astronomique pour 1920 que la réforme radicale que j'ai proposée en 1879, en 1884 et en 1891 étant trop difficile à réaliser, et l'humanité étant incapable d'accepter des solutions rationnelles en quoi que ce soit, nous pourrions nous borner à la simplification suivante :

1° Douze mois partagés en 4 trimestres égaux de 30, 30 et 31 jours, le premier mois de chaque trimestre commençant un lundi et le dernier jour du troisième mois étant un dimanche.

2° Le 1er janvier étant voisin du solstice peut être conservé. Ce serait, tous les ans, un lundi.

3° La fête de Pâques pourrait être fixée au dimanche 7 avril.

4° Les quatre trimestres égaux de 91 jours chacun formant 364 jours, il y aurait un jour de fête=0 pour les années ordinaires et deux pour les années bissextiles.

On aurait ainsi un calendrier perpétuel et universel.

CAMILLE FLAMMARION.

Paris, le 8 mars, 1920.

CALENDAR reformers will welcome M. Flammarion's alteration of his scheme to one which minimises the changes from the existing calendar, while it secures the removal of its anomalies and inconveniences. It would seem advisable to choose some day for the extra-week day that is already a public holiday. Christmas Day, New Year's Day, and Whit-Sunday have been suggested.

From the astronomical point of view the most important amendment is the placing of the leap-day at the end of the year, so that the interval from the beginning of the year to any calendar date is constant.

A. C. D. CROMMELIN.

On Langmuir's Theory of Atoms.

MR. S. C. BRADFORD'S criticism in NATURE of March 11 of Dr. Langmuir's theory is scarcely justifiable, considering that the latter clearly states in his paper (Journ. American Chem. Soc., vol. xli., p. 868, 1919) that the equilibrium positions of the electrons are determined in part by magnetic, and in part by electrostatic, forces, the former necessarily implying electron rotations.

The electrons are probably rotating (some right-handedly, others left-handedly) in very small orbits about certain fixed points, *e.g.* the corners of each cube, the centres of such orbits being the positions of Dr. Langmuir's "stationary" electrons. Such rotations are exactly what is required for the explanation of directed valencies and the paramagnetic or diamagnetic properties of the elements. From magnetic considerations, Mr. Bradford's suggestion as to the nature of the rotation is inconceivable, since the one he prescribes would make fluorine and a number of other elements paramagnetic, contrary to experimental data. Moreover, the frequencies of such rotations, which he suggests might be identified with Bohr's spectral frequencies, would be affected by temperature changes.

Electrons rotating right- and left-handedly about definite points, in small circles the radii of which are small compared with the accepted radius of the hydrogen atom, appear to be necessary; but there is little possibility of reconciling such small orbital motions with the coplanar ones of Bohr, the radii of which are, under normal conditions, essentially of the conventional atomic size, and under certain conditions far larger.

A. E. OXLEY.

University College, London, March 12.

Fireball of February 4.

ON Wednesday, February 4, at 6 p.m., a very bright meteor appeared in the sky at Naini Tal (India). It travelled from west to east at an altitude of about 60°, and was visible for fully five seconds. The yellow fireball left a bluish-white trail, which remained hanging in the air for a considerable time, and then gradually dispersed. About half-way through its course a big puff of vapour came out of the meteor, which probably indicated the bursting. Half a minute later a thundering noise was heard, which continued to rumble for a quarter of a minute. It had been snowing an hour before, but the sky was perfectly clear at that time.

M. L. DEY.

Central Chemical Laboratory, Naini Tal,
India, February 5.

IT is curious that on the same date a large fireball was observed in England at 6.14 p.m., but in this case the object moved from east to west, *i.e.* in a contrary direction to the one seen by Mr. Dey. It is, however, by no means rare that two or more fireballs appear on the same night, though they are seldom members of the same meteoric system.

W. F. DENNING.

Buzzards and Bitterns.

IN the *Times* of March 12 it is stated that "the Lakeland buzzards are extending their breeding range . . . and that a nest was detected in the Buttermere Valley."

It would thus seem that the buzzard was finding its way by instinct to a region where, in old times, it had obtained an easy prey in the bittern, which gave its name to the mere. The early name of the bittern was "butter," and a Buttermere is mentioned in a charter ascribed to A.D. 863 as occurring in Wiltshire. There are a number of place-names in the country involving the designation of the bird, although its "bump" is no longer heard, as by Tennyson's Northern Farmer.

EDMUND MCCLURE.

80 Eccleston Square, S.W.1, March 13.

Ostrich Study in South Africa.

By PROF. J. E. DUERDEN.

THE domestication of the two-toed ostrich in South Africa has rendered available for observation and experiment large numbers of a creature in many respects worthy the attention of zoologists. While this bird's lack of intelligence and absence of any personal recognition may discourage the lover of animals who looks for some response for care and attention bestowed, its towering size, wayward strength, and nuptial viciousness yet engender a wholesome regard. The high industrial importance which attaches to its plumage has made necessary an intensive study of the physiological conditions which influence feather growth, as well as of the genetical considerations which determine its advance. It is true that, as the foundation of an industry appealing only to adornment and luxury, the bird fell on evil days during the war; but the outlook for the future is now encouraging.

Though in the wild state the ostrich is one of the most nervous of birds, its instinctive fear of man the unusual can be kept in abeyance on the farm by close association and constant handling from the chick stage onwards, and with intelligent control it is rendered amenable to all the necessary restraints of domestication. Should neglect occur, however, the wild nature asserts itself, and restraint is afterwards impossible, irresponsive as it remains to any "breaking" process.

During the past fifty years or so the farmer has worked out the main conditions necessary for the production of plumage of the highest excellence, without, however, any concern as to the physiological principles involved. As epidermal outgrowths, growing at the rate of a quarter of an inch a day, the unripe plumes are found to be extremely responsive to any variation in the condition of nutrition of the bird. Even the slight difference of blood-pressure between day and night is often found to leave its impress on the growing feather in the form of an alternation of denser and weaker annulations, while, should the bird be in a reduced state, a kinking of the feather sheath at a ring of night growth may result in the formation on the opened plume of the familiar defects known as "bars" (Fig. 1). Reduced nutrition may even result in complete stoppage of feather growth, particularly in the case of chicks, a new plume pushing out the old on the restoration of better conditions. Of all parts of the body, epidermal structures seem the first to suffer from insufficient nutrition and to retain a more or less permanent impress of it, as is so often exemplified in nails, hoofs, horns, wool, and hair; but in the rapidly growing ostrich plume the response appears more manifest, and an economic importance attaches thereto.

The clipping of the plumes is no more harmful to the bird than is the cutting of the hair or the trimming of the nails to ourselves. They are taken as soon as opened out for fear of deterioration, while the quills are allowed another two months in which to complete their growth. Several helpful facts are disclosed on the extraction of the quills. Thus, the drawing of the quill invariably serves as a stimulus to the germ below, and the new feather appears at the lip of the socket in about a month's time. All being drawn simultaneously, a full, even crop of plumes is secured, each regular and perfect in its growth, owing to mutual protection—a great contrast with a crop from a wild or uncared-for bird, which is made up of plumes at all stages of growth as a result of moulting irregularities. Before maturity of plumage is reached, a feather drawn out of time is intermediate in character between those of the

FIG. 1.—Ostrich plumes showing barring defects and sloping butts, results of reduced nutrition.

plumage before and those coming after. The time of quilling is the most critical of all the operations connected with the farming of the bird, as it determines largely the nature of the succeeding feather crop. The state of nutrition, sexual stage, period of the year, and climatic and food conditions have all to be considered. Where only a single clipping annually is secured, adult birds are, if possible, quilled at such a period as will bring the crop to ripeness about the beginning of the breeding season—that is, the middle of winter.

While the growing plume is highly responsive to changes of nutrition, the farmer soon discovered that the response was limited, and that with all his care only certain birds produced superior plumes. As in other domestic animals where much importance is attached to details of

form and production, great variations in the minutiæ of feather structure were encountered, all of which have a big industrial bearing. Scarcely any two birds produced plumage alike in character, and the whole object of the breeder has been to bring together in a single plume the best of all the characteristics distributed among the original wild stocks. Without any knowledge of Mendelism or of the factorial hypothesis, the ostrich farmer has clearly grasped the genetic distinctness of the innumerable "points" of the plume, and the impossibility of procuring those desired except from birds already exhibiting them. The best plumage birds in South Africa to-day are the product of only two or three original strains; all the rest have been discarded as breeders, through not showing sufficient merit. No new character or mutation in plumage has ever occurred since domestication. Selection in breeding is based on plumage alone, no bodily characters having been found to be correlated with it. It is manifest that any ostrich of weak metabolic activity would necessarily produce a defective plume also and be discarded on performance alone, however desirable the plume factors of the germ might be known to be; hence the farmer is more justified in selecting his breeders on production than he would be in selecting on pedigree alone. It is not much that the geneticist can do for the practical breeder in cases of this kind; he can, however, expound to him the soundness of the principles on which he is working and thereby encourage him in his efforts.

Along with the other members of the ratite group, the ostrich has long been regarded as in many respects degenerate or as undergoing retrogressive evolution. The relative smallness of the wings and the presence of only two toes to the foot are manifest features, but a closer study reveals many other directions in which loss has taken place, particularly in connection with the epidermal derivatives, scales, feathers, and claws. The thousands of specimens available provide ample material for observing the various stages in the process and the manner in which the loss proceeds. In such studies it becomes important to distinguish between diminution in size and the loss of constituent parts of a structure. Thus, although the wings are so disproportionately small, structurally they are actually less degenerate than in any other living bird. The first and second digits bear claws, and the third digit has sometimes a free second phalanx and may bear feathers. The outer toe of the foot is far less in size than would be expected of the fourth in the sauropsidan sequence, yet it retains all its five phalanges. Also, as showing the independence of the degenerative changes one of another, it may be observed that, though the wing is structurally less reduced than in other birds, the foot is unique in having only two toes; it is more degenerate than in any other living bird.

That a type has undergone degeneration in any respect can be established only by comparison with closely related members of the group to which it belongs, comparative anatomy affording us a safe standard. On this basis there can be no question of the various lines of degeneration represented in the ostrich, and if among the multitude of specimens examined differences of degree are met with along these lines, it is a fair inference that they represent the various stages of the process, and reveal to us the manner in which evolution proceeds. Whether the occurrence of these intermediate stages within extremes proves that evolution is actually in progress to-day may be a reasonable inference in the case of such an animal as the ostrich; but, as Prof. Bateson has pointed out, it can be definitely established only by comparisons at long intervals of time showing a general average reduction.

Comparing, then, the various stages in the degeneration of any particular feature of the ostrich, it is found that wherever a sufficient number of

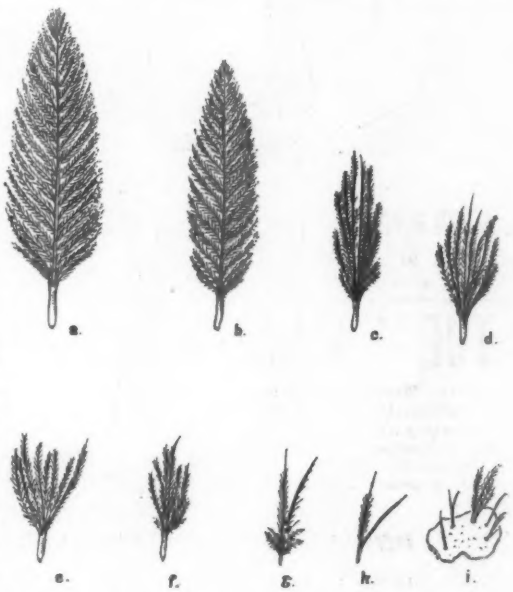

FIG. 2.—Series showing stages in degeneration of a feather.

individuals can be got together a continuous series is presented, linking up the extremes (Fig. 2). Thus birds are to be found with wing quills varying in number all the way from 44 to 33; the under-covering of down may be practically lacking, while all stages occur leading up to a feeble development over the greater part of the body; the under-surface of the wing may be naked with the exception of a much reduced single row of under coverts, but intermediate stages occur culminating in three rows of coverts; many degrees in reduction of the upper coverts are also encountered; the second phalanx of the third finger varies from a free distinct bone to a triangular vestige fused to the end of the first phalanx. On the little toe the claw varies from a stage where it is well developed to one where it is altogether absent, and the scutellation of the big toe may

either be continuous with that on the tarsus or show stages in "breaks" at one or two of the joints (Fig. 3). These and other facts of a like character go to prove that the degenerative evolutionary processes in the ostrich are all *orthogenetic* in their nature, and that a retrogressive change set up in any one direction is likely to be continued until final elimination of the part in question. The continuity is probably more apparent

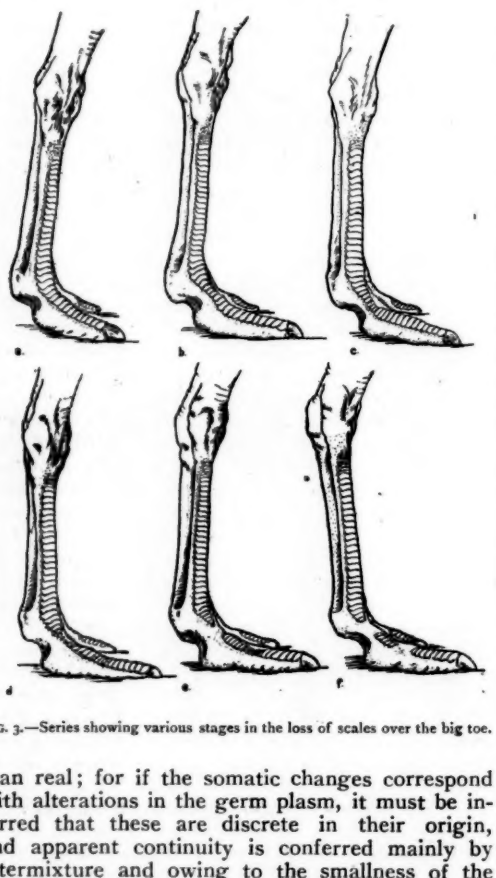

FIG. 3.—Series showing various stages in the loss of scales over the big toe.

than real; for if the somatic changes correspond with alterations in the germ plasm, it must be inferred that these are discrete in their origin, and apparent continuity is conferred mainly by intermixture and owing to the smallness of the changes. The stages must, however, be successional and represent a definite tendency in the germ plasm, in contrast to the haphazard nature of the mutations usually studied—a tendency which is held to be wholly apart from any considerations as to the welfare of the bird, as well as from environmental influences.

To the highly contentious question of the inheritance of acquired characters, the ostrich would appear to have a contribution to offer. Owing to the loss of its second toe, the crouching bird, for mechanical reasons, no longer makes use of the symmetrical axial callosity at the ankle, but develops an accessory one to the side. This is formed anew with each generation, and must have done so ever since the second toe disappeared, though presumably this happened thousands and thousands of generations ago. No hint of the accessory callosity occurs on the newly hatched chick; it is not inherited, but has to be acquired anew each time. On the other hand, the hereditary axial callosity, though unused for the same period, shows no signs of reduction; it has persisted through the ages, though non-functional. Further, the ostrich rests upon its sternal and pubic projections, and a strong callosity is developed over each. These would unquestionably form as a direct response of the skin to the pressure and friction involved in crouching, but are found to be hereditary, showing on the newly hatched chick. Hence we are presented with an hereditary structure which would also be formed independently as a result of the ordinary activities of the bird were it not already provided, strongly compelling us to suspect that the presence of the former is in some manner directly connected with the latter; in other words, that a character originally developed as a result of external stimuli has in time become so impressed upon the organism that it now makes its appearance apart from the primary stimuli.

The question of the origin of the three or four species of ostrich also makes some appeal to the evolutionist. No one intimately acquainted with the northern and southern ostrich would dispute their specific distinctness, but the East African and Somali species appear to be founded on intermediates of the two. Moreover, the northern and southern birds freely interbreed, and their offspring are fertile, some of the characters blending and others showing Mendelian segregation. Unquestionably all the representatives of the genus Struthio are a common stock, continental in their distribution, in which mutations have occurred in certain areas and not in others, but not of such a nature as to prevent free interbreeding.

The Conservation of Our Coal Supplies.[1]

By PROF. J. W. GREGORY, F.R.S.

COAL is the main material foundation of British industrial supremacy. The importance of coal is given by Mr. Justice Sankey as his first reason for its State ownership. The rapid British industrial progress at the end of the eighteenth century was due to our abundant coal. Modern coal mining began in Belgium earlier than in Britain, but British mines soon had the greatest output in the world. In 1800 they produced two-thirds of the world's coal, in 1860 the proportion was 60 per cent., and in 1913 the United States,

[1] Address to the Philosophical Society, Glasgow, on March 10.

Britain, and Germany together produced 87 per cent. of the world's coal. It was not until 1899 that the British output was surpassed by that of the United States; but, in spite of the ease of working of the American fields, our yield per unit of coal area is sixteen times as great as that of America. The British output of nearly 300 million tons is irrefutable evidence of the skilful organisation of the British coal industry and of the courage and capacity of the British miner.

This drain of 300 million tons a year inspires disquietude as to how long it can last. The first authoritative estimate of our coal resources was that of the Royal Commission of 1865, which estimated them as roughly 150,000 million tons. Later estimates have increased this amount to about 200,000 million tons, which would maintain the 1913 output for 600 years; the United States supplies would be maintained for 1500 years, those of Germany for more than 1500 years, while the coal fields of China would last for several millenniums. The world is in no immediate danger of a coal famine, but the British industrial position is threatened by the continued rise in the price of coal, which may hamper competition with countries with cheaper supplies. Jevons in 1865 issued a warning of this danger, and his main prediction has been amply justified, for during the seventy years from 1834 to 1904 the price of coal almost doubled, while that of general commodities fell by about a quarter. The increased cost of coal cannot, therefore, be explained by such influences as variations in currency.

The maintenance of the British output at a price which will enable British manufacturers to compete with those of foreign coal-producing countries depends on the increase of our coal reserves by the discovery of buried coal fields, such as doubtless occur under the younger rocks of eastern and southern England, while an extension of the Scottish coal fields may occur in north-eastern Ireland under the lava sheets of Antrim. The coal field of South Yorkshire and Nottinghamshire has been enlarged since 1905 by the discovery of 400 square miles of coal-bearing country, most of which is already being worked or developed. The eastward extension of this field is less than was expected by the Coal Commission of 1905, but its eastern and southern margins are still undetermined. The Kent coal field was found, in consequence of a geological prediction, during boring operations at Dover in connection with the Channel tunnel. Private bores for water have thrown light on the possible range of the coal in the south-east of England, but there are large areas which are unlikely to be tested by private enterprise. It is deplorable that they should be left unproved, as a few bores between the Nottinghamshire and Kent coal fields, and between London and Bristol, might lead to the discovery of very important additions to the national coal reserves. Such bores should be put down at the national expense, the cost, if successful, being charged to the area benefited.

As much light may be thrown on the distribution of concealed coal by private bores, the journals of all deep bores should be communicated to the Geological Survey and published either annually or, if desired by those who have paid for them, after an interval of ten years.

The national coal supplies will be increased by the working of deeper seams. The extreme limit of coal mining has been regarded as 4000 ft., but that depth has been greatly exceeded in metal mining, and 4900 ft. is the accepted Continental limit for coal mining.

The working of thinner seams is becoming practicable by the use of machinery and by working coal in conjunction with the adjacent clays; but the extension of thin-seam working would be hindered by a Government scheme for the nationalisation of coal. The nationalisation of all minerals, since clay and limestone often form the ground in large areas, would mean the nationalisation of the land. The nationalisation of coal alone would seriously hamper that combined working of coal with clay or limestone on which the development of thin-seam working is mainly dependent.

It may also pay the nation to arrange for the extraction of seams so thin that they cannot be worked at a profit, for if the labour be available the direct loss may be recompensed from the profits earned by the coal in other industries. It has often been suggested that to make our coal last longer the output should be restricted, but that policy, fortunately, appears now to have no advocates. The universal demand is for an increased output. Its restriction is opposed to the sound commercial principle, "Use an asset while you can." Unrestricted output is, however, justifiable only so long as coal is used economically. Great savings are possible. Sir George Beilby estimates that the average British consumption of coal per horse-power per hour is 5 lb., and that it should be no more than 1½ lb., thus saving 56 million tons of coal a year. Greater saving appears possible by economy in the use of coal than from the numerous alternative sources of power, though resort to them will become necessary if coal prices rise.

Economy in coal is the most promising method of reducing the drain on our coal reserves. The country has used only about 6 per cent. of its total coal. Our coal supply would maintain the 1913 output for centuries, but if the annual output increases until, as some authorities expect, it is trebled, the handicap of high price may be on us in less than a century. By economy in coal consumption great industrial expansion is possible on the present output.

The essential factors with regard to the coal question are that no other source of power is available in this country on a large scale; coal is still indispensable, while it is limited in amount and irreplaceable; and, owing to the exhaustion of the more easily worked seams, a steady rise in price will continue, and probably at an accelerated rate. Ultimately the nation must enforce economy in the consumption of coal, prevent waste in mining, and be prepared to work seams at a

direct financial loss. The coal industry can be conducted on those lines in accordance with three possible policies—nationalisation, one coal trust for all the British fields, or group working by a combine for each coal field, co-ordinated by national control. Which of these policies is best is not a geological question. The problem for geologists is whether one of these policies is necessary at once, owing to the diminution of our coal reserves. The recent rise in the price of coal has been due partly to a just increase in miners' wages, partly to the higher costs of supplies, and partly to some spontaneous hypertrophy of price in distribution. Compared with these influences, the contribution to the soaring of coal prices by the geological factors is trivial. The conditions of our coal supplies do not render immediately necessary any drastic action in the conduct of the industry. In countries such as India, where the total coal reserves relative to the area and population are small, nationalisation may be the soundest economic policy, but we are far from the time when the three great coal-producing countries—the United Kingdom, the United States, and Germany—will find nationalisation necessary owing to the approaching exhaustion of their coal supplies.

The direct issue before the nation at present is between national ownership of the minerals with centralised Government control of mining—which may give us the drawbacks of nationalisation without its advantages, and is repudiated by both the miners and the mine owners—and a scheme of nationalisation combined with local administration of the industry by those engaged in it. The issue between nationalisation and the pre-war system may not be put to the nation unless as a result of the conflict between the nationalisers who advocate central control and those who advocate local control. The pre-war system has no chance of permanence unless developed to give the miners better conditions and a share in the control and financial fluctuations of the industry, combined with regulations to enforce economy in the use of coal and to secure less waste in mining, and with the determination of the extent of the concealed coal fields on which the future of the country will ultimately depend.

Obituary.

PROF. CHARLES LAPWORTH, F.R.S.

THE work of Prof. Charles Lapworth (who died on Saturday, March 13) in the sciences of geology and geography will continue to influence and inspire the growth of these sciences for many years to come. At the moment we can but mourn the loss of one worthy to be classed with the greatest of the old masters.

Gifted with a vivid and flexible imagination which he kept in his most brilliant excursions well under the control of his data, with unwearied patience in the collection of fact by his own observation or that of others, with an active and most orderly mind for grouping and arranging ideas, with the moral courage to hold his hypotheses in test until the survivors of them became proved theories, with a perfect genius for stratigraphy, an instinct for geometry, and the hand of an artist, Lapworth had the qualities requisite to bring the study of the older palæozoic rocks to the level of an exact science, to throw new light on the mechanism of earth-movement, and to forge the links between geology, "the geography of the past," and the geography of the present.

In 1864 Lapworth grasped the opportunity of work in the Southern Uplands, the country redolent of Scott, his favourite author. Spending every leisure moment in walking over ground thus made sacred to him, and possessing the gift of close and accurate observation, he could not help becoming interested in the landscape and the rocks; and he soon found himself studying the geology of the region in company with his friend James Wilson.

It happened that the landscape of this area concealed under an aspect of simplicity, but revealed to the eye of genius, a rock-structure of extraordinary complexity, to which there was apparently no clue except a few obscure pen-like markings, called graptolites, in the Moffat shales; and these had been tried for the purpose, but "turned down" as useless. Lapworth, however, determined to give them a second chance, and, as a result of systematic collecting, a keen eye for a country, and a retentive memory for minute, but significant, lithological variation, accompanied by a more elaborate piece of geological mapping than his predecessors had ever attempted, succeeded in proving that they could be used to unravel a rock-succession, even though it was more crumpled, inverted, and tangled than any other then known.

The rock succession and tectonic structure thus made out were tested against the simpler succession and relations and the more normal fossils of the Girvan area, and proved correct. At the same time, the graptolite zones that Lapworth had established were tested by comparison with successions made out partly by others, but mainly by himself at home, and by workers in Scandinavia, Bohemia, etc., proving that he had successfully performed at Moffat the double feat of working out the succession by means of the structure, and the structure by the succession.

The correct reading of the Uplands having shown that an apparently simple upward succession might be altogether misleading, and that this region gave support, and not contradiction, to general laws previously established in the organic and

inorganic world, suggested the probability that the varying interpretations of the Highland problem might admit of a like solution. While Lapworth was able to carry and apply his tectonic principles to the Highlands, definite organic succession now failed him, and he was driven to depend mainly on his stratigraphical methods applied to variations which were mainly lithological. Again, most elaborate mapping, and something akin to inspiration in the interpretation of it, came to his aid, and in a few months he had proved that the secret of the Highlands was that the region was the basal wreck of an ancient mountain chain exhibiting tectonic features akin to those worked out by Escher and Heim in the Alps. Lapworth was passing forward to the fuller study of the metamorphic area of the Highlands when his work was cut short by illness, and, in spite of his wish to do so, he was never able to take it up again.

The tectonic work, however, led on to the suggestive study of the rock-fold, which formed the subject of his address to the British Association at Edinburgh (1892), in which he passed from the structure of mountain chains to that of continents and oceans, and onward to the antilogous crests and troughs of the earth's crust as a whole, including that great "septum" the Pacific girdle of fire, the "wedding-ring of geology and geography." Later, Lapworth laid before the Geologists' Association his conception that a great continental wave sweeping round the earth would produce results analogous to those revealed by the succession of stratified rocks. In this, as in his other work, while possessing deep and sympathetic knowledge of the researches of such geologists as Suess, Heim, and Bertrand, he held steadily to the views of the mechanics of the earth's crust to which his independent thought had led him.

The success of his own graptolite work and the keenness with which it was being followed up by young observers led him to propose a new classification of the Rhabdophora, and to contemplate a monograph on the Order. This has now been completed by Miss Elles and Mrs. Shakespear under his guidance and editorship.

Although his duties at Birmingham, and the great amount of professional work involved by his position there, kept Lapworth fully occupied, his ideal diversion was always the discovery of new facts and their delineation on maps. Field classes, week-ends, and longer holidays were always devoted to this, resulting in the completion of large-scale maps of Nuneaton, the Lickeys, Dudley and the Coal-field, the Wrekin, the Longmynd and Caradoc, the Shelve country, and, last but by no means least, with his friend Dr. Stacey Wilson, the Harlech area. Little of all this work has been published. He loved to add to it, to improve and polish it, to fill in difficult corners in detail, and to show his treasures to his friends, delighting that they should realise some of the steps which led to his conclusions, and appreciate some of the labour of discovery.

As a great teacher Lapworth earnestly desired to equip his students to take their share in furthering the advance of science and to remove anything that could retard its progress. It was only fitting that the man who had stilled the Lowland controversy, and wrested its secret from the Highlands, should give the law in the "Silurian" controversy and make the opponents sink their differences by the adoption of his term "Ordovician."

Sir Thomas P. Anderson Stuart.

It is with deep regret that we have to record the death, on February 29, in Sydney, of Sir Anderson Stuart, the well-known and highly respected professor of physiology in the University of that city, and the dean of its medical faculty. He had been in failing health for some months previously, but the fatal outcome of his malady was unexpected by his numerous friends.

Anderson Stuart was born at Dumfries in 1856, and was the son of Alexander Stuart, Dean of Guild. He received his early education at the Dumfries Academy, and later studied in Germany (Wolfenbüttel and Strassburg) and in the University of Edinburgh, where he graduated M.B., Ch.M. with honours in 1880. The next year he was appointed assistant of the professor of the Institutes of Medicine at Edinburgh, and later took the M.D. at that University, obtaining the gold medal.

It was in 1883 that Anderson Stuart went to Australia as professor of physiology at Sydney, which post he held until his untimely death. His was a forceful character, and he threw himself with enthusiasm into the work of teaching and research there. He will be remembered for many useful pieces of original work in connection with the circulation, the physiology of swallowing, and the eye. His various models and schemata, in which he manifested extreme ingenuity, are standard helps to teaching in all modern laboratories. His work as dean at a later stage in his career brought the medical school into high repute, and at the meeting of the British Association in Australia in 1914 he pointed out with justifiable pride the new buildings of the medical school, fully equipped with all modern appliances and accommodation for research and teaching, which formed the successful culmination of his efforts.

But Anderson Stuart was more than a professor, more even than a dean; he was a sagacious man of the world, and was appointed on many occasions delegate by his University to various international congresses, and consulted by the Government of New South Wales on many questions of public importance mainly related to educational problems. He was thus a well-known figure, not only in Great Britain, but also in other European countries.

In his adopted country Anderson Stuart's life was a long story of official appointments successfully discharged. He was twice president of the Royal Society of New South Wales. He was medical adviser to the Government of that colony,

and took a prominent part in all public health and educational movements; he was health officer to Port Jackson, president of the Board of Health, chairman of the board of the Royal Prince Alfred Hospital, trustee of the Australian Museum, and held many other public posts too numerous to mention. His activities in so many directions were recognised by the conferment of honorary degrees (M.D., Universities of Melbourne and Sydney; LL.D., University of Edinburgh; D.Sc., University of Durham), and finally by the honour of knighthood in 1914.

Anderson Stuart was held in high affection by his students, colleagues, and numerous friends in both hemispheres. He leaves a widow and several sons (who saw service in the recent war) to mourn his loss, and to them our heartfelt sympathy is offered.

By the death of Mr. J. S. MacArthur on March 16 industrial chemistry has lost a notable exponent. Mr. MacArthur's name will always be remembered in connection with the Forrest-MacArthur patent for the extraction of gold from its ores by means of cyanide. It is given to few men to discover a process which has had such a far-reaching effect in almost every branch of civilised life. The influence of an enormously increased quantity of gold available for mankind has been—as, indeed, it must be—profound, no matter whether it is for good or for evil. Compared with the huge sums of money involved, the amount accruing to Mr. MacArthur out of this patent was infinitesimal. His type was essentially a pioneering one. The initial work in connection with the extraction of gold was carried out with small funds in a laboratory which was in reality a cellar at the back of a Glasgow tenement house. After this work was completed, Mr. MacArthur engaged in many commercial ventures in connection with chemistry and mining, but, with the possible exception of his last, none of them seemed to possess the elements of permanent success. This was the extraction of radium from its ores, which he carried on first of all in Cheshire, and then practically on the shores of Loch Lomond, in order to avail himself of the purest possible water. He was proud of his works there, and delighted to feel that he was able to carry on his work in the midst of such beautiful surroundings. Mr. MacArthur's personality was delightful and genial. His travels had been world-wide, and to anyone interested in mineralogy and travel he was indeed entertaining.

Mr. James Procter, whose death occurred on March 6, was born in 1841. He took a prominent part in the design and manufacture of the engines required for blast-furnace work and iron and steel works, and is said to have been the first British engineer to construct blowing engines with mechanically controlled valves. Mr. Procter was a member of the Institution of Mechanical Engineers and of the Iron and Steel Institute.

Notes.

As president of the British Association at its meeting in Cardiff on August 24–28 next, Prof. W. A. Herdman, of Liverpool University, will deal in his inaugural address with oceanography, of which he will give a general survey, and discuss in detail certain special problems and recent investigations, with particular reference to the sea-fisheries. The following presidents of sections have been appointed:—A (Mathematics and Physics), Prof. A. S. Eddington; B (Chemistry), Mr. C. T. Heycock; C (Geology), Dr. F. A. Bather; D (Zoology), Prof. J. Stanley Gardiner; E (Geography), Mr. J. McFarlane; F (Economics), Dr. J. H. Clapham; G (Engineering), Prof. C. F. Jenkin; H (Anthropology), Prof. Karl Pearson; I (Physiology), Mr. J. Barcroft; K (Botany), Miss E. R. Saunders; L (Education), Sir Robert Blair; and M (Agriculture), Prof. F. W. Keeble.

In the interests of physiological and medical research, we may congratulate ourselves that the debate on the mischievous and unnecessary Dogs Protection Bill of Sir F. Banbury was "adjourned" on Friday last. Owing to the length of the discussion on the really important Early Closing Bill, that on the former Bill was prolonged until the rising of the House. It may be pointed out once again that no other animal of the size of the dog can be kept under laboratory conditions in a healthy state, and that the general chemical changes in this animal are closely similar to those of man, mainly owing to its omnivorous nature. The letter by Dr. Thos. Lewis in the *Times* of March 19 shows how obstructive the exclusion of the dog would be to one branch of investigation of great practical utility; and an equally strong case could easily be made out for many others. The report of the last Royal Commission on Vivisection shows that adequate provision against any possible cruelty has already been made, even if it were necessary to do so.

His Majesty the King has approved the award of the Royal medals of the Royal Geographical Society as follows:—Founder's medal to Mr. H. St. John B. Philby, for his two journeys in south-central Arabia, 1917 and 1918; and Patron's medal to Prof. Jovan Cvijic, Rector of the University of Belgrade, for distinguished studies of the geography of the Balkan Peninsula. The council of the society has awarded the Victoria medal to Lt.-Col. H. S. L. Winterbotham, for his exceptional services to the country in the initiation and development of scientific methods of artillery survey and the production of high-class maps of inaccessible areas. Other awards are:—Murchison grant to Miss Czaplicka, for her ethnographical and geographical work in northern Siberia; Cuthbert Peek grant to Mr. A. W. Pearson Chinnery, to assist him in continuing his work in the unexplored parts of New Guinea; Back grant to Mr. J. M. Wordie, for his scientific work on the Antarctic Expedition of 1914–17; and Gill memorial to Mr. Reginald Farrer, for his journeys on the Chinese borders of Tibet.

SIR JOSEPH LARMOR has been elected a corresponding member of the French Academy of Sciences in the section of geometry.

AT the meeting of the Royal Irish Academy on Tuesday, March 16, the following were elected honorary members in the section of science:—M. Henri Louis le Châtelier, Prof. George Ellery Hale, Prof. Augustus Edward Hough Love, and Sir Ernest Rutherford.

A COMMITTEE has been appointed to consider and report to the Minister of Transport on the question of the electrification of railways. The Committee is constituted as follows:—Sir Alexander Kennedy (chairman), Sir John Aspinall, Mr. A. R. Cooper, Mr. Philip Dawson, Sir Alexander Gibb, Mr. C. H. Merz, Sir Philip Nash, Sir John Snell, Sir Henry Thornton, and Major Redman.

THE Recording Secretary of the Nova Scotian Institute of Science has been good enough to inform us that at a meeting of the institute held at Halifax on March 8, on the motion of Mr. H. Piers, seconded by Dr. D. Fraser Harris, it was "resolved that the Nova Scotian Institute of Science convey to the publishers and Editors of NATURE, London, its congratulations on the occasion of the fiftieth anniversary of the establishment of that well-known scientific journal, and wish them continued success in the future." On behalf of the publishers, and for ourselves also, we thank the institute for its kind resolution of appreciation and trust.

A PROJECT for systematic exploration in Mediterranean oceanography was started at an international conference recently held at Madrid. According to *La Géographie* for January (vol. xxxiii., No. 1), the States represented were France, Italy, Spain, Greece, Monaco, Egypt, and Tunis. A commission was founded, with headquarters at Monaco and the Prince of Monaco as president. This commission will consider the methods to be adopted. Ships for the work are under construction or being planned by France, Italy, Spain, and Monaco. A beginning will be made this spring, France and Italy working in the Dardanelles and Monaco and Spain in the Straits of Gibraltar. The secretary of the central commission is Dr. J. Richard, Musée Océanographique, Monaco.

COL. VAN RYNEVELD and Capt. Brand arrived at Cape Town on March 20, and thus accomplished a flight along Africa from north to south. Three machines were used. The first left Brooklands on February 4 and was wrecked at Wadi Halfa on February 11. A new start was made from Cairo on February 22 with an aeroplane fitted with the engines from the first machine, and a flight was made so far as Bulawayo, where the machine crashed on March 6. On March 17 a machine was supplied by the Union Government to replace this, and with it Col. van Ryneveld and Capt. Brand completed their African air route of more than five thousand miles. Though not associated with scientific observation during the journey, the flight is a notable feat in the history of aviation.

DR. CHALMERS MITCHELL, in cablegrams from Dares-Salaam, published in the *Times* of March 15 and 16, graphically summarises his impressions on the physiography of the Nile basin as seen in his flight from Cairo to Tabora. His despatch depicts the unity of the processes which have moulded the surface of north-eastern Africa. The dominant features due to earth movements are being slowly smothered by sheets of sand and silt deposited in river deltas, in the marginal lakes formed where tributaries are barred entrance to the main river by the raising of its bed and banks, and in wide basins slowly being converted to plains by wind-borne dust. Dr. Chalmers Mitchell represents East Africa as having been cracked, whereas most other lands have been folded, and its vastest plains as due more to wind than to water. The lowlands are being filled by sub-aerial drift which buries the lower irregularities, and leaves the peaks rising abruptly out of the plains like reefs through the sand upon a shore. In the second part of his report Dr. Chalmers Mitchell refers to the beauty of the country, despite its aridity, and offers strong testimony to the progress which has been achieved in the Tanganyika territory, owing to "much ingenuity and vast expenditure of money, well laid out." His remarks on the elephants, giraffes, and antelopes observed during the flight show that the aeroplane would be of great service to sportsmen in the search for big game.

IT has frequently been suggested that the very heavy cylinders used for compressed gases are now out of date, and that the advances made during recent years in the science of metallurgy, particularly in connection with steel and its alloys, should enable a vessel to be produced which is lighter as well as safe. In consequence of these suggestions the Department of Scientific and Industrial Research formed a Gas Cylinders Committee in 1918, the members of the Committee being Prof. H. C. H. Carpenter (chairman), Prof. C. V. Boys, Prof. E. G. Coker, Dr. J. A. Harker, Major Cooper-Key, Prof. F. C. Lea, Eng.-Capt. J. McLaurin, Sir Charles Parsons, Major C. J. Stewart, and Prof. J. F. Thorpe. Compressed gases were much used during the war for various purposes, such as, for example, in supplying oxygen for airmen flying at high altitudes and for poison-gas warfare. Industrially also, in war, as in peace, there has been an immense development in the use of oxygen and acetylene for welding, of carbon dioxide and ammonia for refrigeration, of hydrogen for ballooning, etc., which no doubt will be maintained. Arising from the necessity of war, very light cylinders have been manufactured for the purposes above mentioned, and slightly heavier cylinders were made to an Admiralty specification. The Gas Cylinders Committee, in conjunction with the leading tube manufacturers, has made a number of tests of cylinders based upon these war specifications, and it is hoped that as a result of this work it may be possible to recommend the adoption of cylinders considerably lighter than those now in general use.

THE first engineering school to be established in London was that at University College. Since 1828

a succession of engineers have been educated there under an eminent series of professors, and it would be a thousand pities if its work in this direction were now to be cramped for lack of funds. The case was ably put by Prince Arthur of Connaught at a lunch at the Savoy Hotel on Friday last. His Royal Highness explained that the present scheme of extensions of the engineering laboratories of University College had a pre-war inception, and he paid a tribute to the valuable anti-submarine and other electrical research work carried out during the war by the professors at the college. The war had made us realise the necessity for adequate provision for scientific education and research, and he urged the need for the laboratories opened twenty-seven years ago by his father to be modernised and brought up to date. Twenty-four thousand pounds out of the 100,000*l.* which they were asking for had already been subscribed, including 10,000*l.* from Lord Cowdray in memory of his son, the Hon. F. G. Pearson, who lost his life during the war. Lord Cowdray had also promised a further 10,000*l.* when a total of 70,000*l.* had been collected. Dr. Russell Wells (Vice-Chancellor of the University of London) also emphasised the necessity for improved technological education for the future prosperity of the country, and announced further subscriptions aggregating more than 4000*l.* Sir Ernest Moir (honorary treasurer to the fund) supported the appeal, and Sir Robert Hadfield referred to the valuable research and educational work done at the college, which could not be continued without adequate funds. Sir Gregory Foster (Provost of University College) explained how important it was that the extensions should be put in hand without delay, and pointed out that, although the Government policy was to provide grants for maintenance purposes, capital expenditure had to be met entirely by voluntary subscription.

A PAMPHLET entitled "Currency Reform and the Need for a Nickel Coinage on a Decimal Basis," issued by the Decimal Association, directs attention to the recommendations in favour of decimal coinage which have been made from time to time by committees appointed by the Government to consider the question of currency reform. The simplification of account-keeping and of conversions of values into foreign equivalents which the introduction of a decimal coinage would necessarily secure is an advantage which would benefit the whole of our business community, and, in addition, effect a great saving of time in our schools. The Decimal Association is in favour of the pound-mil system, which retains our gold coins and replaces the present bronze coinage by new denominations of 4 per cent. lower value. The main objection to the alternative decimal systems is that they would impair the prestige of the pound sterling, which under the pound-mil system is retained intact. Proposed changes in the materials of our coins are now under consideration by the Government, and the pamphlet urges that the opportunity should be taken to get rid of our present inconvenient system and introduce a new coinage on a decimal basis.

THE second of the Chadwick public lectures on military hygiene was delivered by Gen. Sir John Goodwin, Director A.M.S., on March 15. The lecturer reviewed the Army hygiene during the recent war. The clothing served out to the troops was of the best, and special attention was devoted to feeding and rationing. The water-supply in large measure was subjected to chlorination in order to purify it, bleaching-powder being principally used for the purpose. Special measures were taken for cleansing purposes, bathing stations being established where the men bathed, and in the meanwhile their uniforms were sterilised and fresh underclothing was served out to them. Destructors were built, or extemporised out of biscuit-tins, etc., in which all the camp refuse was burnt. Special means were devised to prevent waste. Thus in the destructors all the solder from old tins was melted out and collected, and fat from the kitchens was saved and sent home for manufacture into glycerine and munitions. By these measures the health of the Army was preserved to a degree unknown in former campaigns. For example, in 1916, among a total strength of a million and a quarter of all nationalities, the number of cases of enteric fever was 0·2 per 1000 men, whereas in the Boer War the figure was 153 per 1000.

THE February number of the *Museums Journal* contains the report of a conference between Sir Amherst Selby-Bigge, Secretary of the Board of Education, and representatives of the Museums Association, headed by Sir Martin Conway, on the proposed transfer of museums to the local education authorities. The association presented a reasoned protest, laying stress on the fact that the educational activities of museums must necessarily be subsidiary to their primary function of collecting and preserving the works of Nature and of man, and to the study of this material in prosecuting "the highest aim of a museum . . . the advancement of science, art, and industry." It is the results of that study which eventually become available for the education of the public. The arguments in favour of linking up all the museums of the country with the national museums under the control of a separate museum board were advanced by Dr. Bather, who instanced among the prospective advantages of such an arrangement "the loan-circulation of natural history and other objects from the British Museum, the provision of expert help, and the cataloguing of the wealth of our scattered museums." Sir A. Selby-Bigge, in his reply, claimed that the conception of education had recently widened so as to include the chief functions which the deputation assigned to museums. The previous number of the *Museums Journal* reprints, with comments, the recommendations concerning the staffs of the national museums made by a Royal Commission, the report of which (Cd. 7338), issued in April, 1914, was obscured by the smoke of war.

A "SPECIAL Report on the Prevention of Venereal Diseases," by Dr. A. Mearns Fraser, Medical Officer of Health for Portsmouth, has recently been addressed by him to the Health and Housing Committee of the

Borough Council, and is worthy of the careful consideration of all authorities concerned with national health. Dr. Fraser urges that the highest aim of a health authority should be the prevention, not the treatment, of disease, and that the necessity for extensive provision for treatment is evidence of the neglect or failure of prevention. He shows clearly that the successful prevention of venereal disease by scientifically accredited means can be achieved only by the adoption of certain sanitary measures which are readily available and easily applicable. These measures consist in the use of a solution of permanganate of potash immediately after exposure to infection and of an ointment containing calomel. The provision of these disinfectants by any local health authority is not suggested, but the authority is recommended to take such steps as are necessary to spread the knowledge of the means of self-disinfection, so that those who insist on satisfying their sexual appetites by promiscuous intercourse may be instructed how to protect themselves from diseases which, when contracted, are notoriously so often communicated to innocent women and children. Since it is far more easy to disinfect men than women, it is rightly urged by Dr. Fraser that it is of the first importance to prevent the infective germs from entering the body of the male, for if one sex can be protected from infection venereal diseases will be well on the way towards extinction. The report gives ample consideration and reply to various objections which have been persistently made against the inclusion of venereal diseases in the category of infectious and preventable diseases which can now be dealt with on scientific lines.

A CURIOUS case of stone worship is described by Mr. H. A. MacMichael among the Tungur-Fur tribe in the Sudan (*Sudan Notes and Records*, vol. iii., No. 1, January, 1920). The stone is known as the "Bride's Stone" or the "Custom Stone." Rites are performed on marriage, at the circumcision of a child, at a birth, and when a high official visits the place. But that at marriage is, as the name implies, the most usual. After the marriage rite the pair are made to rub some blood of a sacrificed animal on the stone in the form of a cross. If they are too poor to afford this, they offer a piece of cowdung. Then they are taken to a neighbouring well, where the officiant takes a piece of mud from the pool, daubs it on the foreheads, shoulders, waists, knees, and loins of the couple, and binds some green grass on their necks, ankles, and wrists—all doubtless intended as a fertility charm.

LAST year the Norfolk and Norwich Naturalists' Society attained its jubilee, and we congratulate its members on their fifty years of good work. The very name of "naturalist" is in danger of extinction. Our pursuits are so specialised that we have ornithologists, marine biologists, and protozoologists who yet could scarcely be called naturalists. Another peril to the name of naturalist was brought about by Mr. Arthur Balfour's use of the word "naturalism" to denote what other people call "materialism." It would be a thousand pities to lose familiarity with this most honourable name of naturalist, or to pervert it to a false use. Happily, we are safe so long as the Norfolk and Norwich Naturalists' Society flourishes, and others like it. Its latest number of Transactions (vol. x., part v., 1918–19) is altogether admirable, with Mr. W. P. Pycraft's paper on "Some Neglected Aspects in the Study of Young Birds," Mr. Robert Gurney's "Breeding Stations of the Black-headed Gull in the British Isles," and Mr. W. G. Clarke's "The Fauna and Flora of an Essex Common." The whole issue is well illustrated and well edited; and Dr. Sydney Long, the society's hon. secretary and editor, says truly that new problems and new points of view continually arise. "It is to be hoped that members of our society may devote attention in the future to such questions as the limiting factors in the distribution of our flora and fauna, to the peculiar physical and biological features of our great asset, the Norfolk Broads, or even to such practical questions as the advancement of agricultural methods by the application of modern ideas on heredity and soil fertility."

THE Sumatran hare (*Nesolagus Netscheri*) is one of the rarest of known mammals. Hitherto only two specimens have ever found their way into a museum, and these are in the Natural History Museum at Leyden. Messrs. E. Jacobson and C. Boden Kloss are therefore to be congratulated on being able to describe four recently captured examples in the Journal of the Federated Malay States Museums (vol. vii., part iv.). The specimens were obtained by Mr. Jacobson after a long and almost hopeless search in south-west Sumatra. In its coloration this animal is remarkable, being broadly striped with dark brown on a "buffy or greyish" background, forming a striking pattern, which is admirably shown in two photographs of a living animal. The skin of this creature is so exceedingly thin that it was possible to prepare the specimens captured only after hardening in spirit. It is nocturnal in its habits, and haunts the remote parts of the forest at an altitude of from 600 to 1400 metres. Hence it is almost unknown, even to the natives. So far as can be ascertained, it would seem to live in burrows at the base of big trees or in holes in the ground made by other animals. Mr. Jacobson succeeded in keeping one of the specimens here described for more than a year, during which time it fed readily upon cooked rice, young maize, bread, and ripe bananas. But its favourite food in the wild state would appear to consist chiefly of the juicy stalks and leaves of different species of Cyrtandra, which plants form a large part of the undergrowth of the forests in which it lives. Repeated experiments showed that these plants were preferred to all others, and were consumed in large quantities.

THE *Philippine Journal of Science* (vol. xiv., No. 6) contains an account by H. A. Lee and H. S. Yates of the so-called "pink disease" which has recently appeared in the Philippines, spreading rapidly and causing serious stem- and branch-disease of citrus-trees. The organism is a well-known fungus, *Corticium salmonicolor*, which, though not previously reported upon citrus, is known to cause disease on rubber-trees (*Hevea brasiliensis*), cocoa, coffee, and

other plants, economic and wild, in the Orient, where it is now widely distributed, though in 1900 the disease was practically unknown.

THE Journal of the Franklin Institute for February contains the address on "Sound-ranging as Practised by the United States Army during the War" delivered at the meeting of the physics section of the institute in October last by Prof. A. Trowbridge, of Princeton University. The methods used were those developed by our own Sound-ranging Section, and are known to many of our readers. They depend on the differences of the times of arrival of the sound of a gun at six stations near the gun, and are both sensitive and instrumentally very accurate. The residual errors are almost all due to uncertain meteorological conditions at the time of observation. As compared with other methods of location of enemy guns, the American experience is summed up in the following numbers:—During a three weeks' rapid advance sound-rangers accounted for 21 per cent., and flash-rangers for 79 per cent., of the guns located. During the two following weeks, when the advance had been checked, sound was credited with 54 per cent., and light with 46 per cent., of the locations. These records are characteristic, and show that the Sound-ranging Section required a little longer to get into efficient action than the Flash-ranging Section.

WE have received a copy of the first volume of the *Chemical Age* (June–December, 1919). Besides more or less ephemeral matter, the volume contains a number of important articles possessing a permanent interest. Among these may be mentioned "The Chemist's Place and Function in Industry," by Sir Robert Hadfield; "Recent Developments in Industrial Catalysis," by Dr. H. S. Taylor; "The Commercial Synthesis of Organic Compounds from Acetylene," by Mr. M. J. Marshall; and "The Synthesis of Ammonia," by Dr. E. B. Maxted. A useful feature of the journal is the weekly account, with illustrations, of patent literature; this keeps the reader early in touch with advances made both in this country and abroad, and will be of value to the industrial chemist and the chemical engineer. It is satisfactory to find that the promising standard of the early numbers is well maintained in the later issues.

IT is more than a hundred years since Sir Humphry Davy first described his wire-gauze safety lamp to the Royal Society (1818). The chief use of the lamp has, of course, been in the coal-mining industry. Danger of gaseous explosions also exists, however, in various chemical works where inflammable liquids are dealt with, a frequent cause being the use of naked lights in the repair or cleansing of large holders in which such liquids have been stored. Even at some distance from the liquid a naked light may be dangerous, as vapour given off may render the atmosphere capable of propagating flame. Attention is directed to this fact in the Journal of the Society of Chemical Industry (February 28) by Mr. W. Payman, who advocates the use of some form of safety lamp where artificial illumination is required in such circumstances, and describes various forms of lamp suitable for the purpose.

ENGINEERS who have to solve problems based on the properties of steam, and especially those connected with steam turbines, will welcome a new alignment diagram constructed by Mr. D. Halton Thomson, and published in *Engineering* for March 5. The principal part of the diagram is based on Callendar's equations for the properties of steam, and by applying the principle of duality Mr. Thomson has succeeded in producing an alignment diagram which represents not only the simpler of the Callendar equations, but also the others not hitherto amenable to this treatment. The diagram has scales showing (*a*) the total heat of superheated or supersaturated steam, and also the total heat of wet steam; (*b*) the amount of superheat; (*c*) the dryness fraction; (*d*) the total entropy; (*e*) the hydraulic efficiency for multi-stage turbines during superheated or supersaturated expansion; (*f*) the specific volume of superheated or supersaturated steam, and also of wet steam; (*g*) the absolute pressure; and (*h*) the saturation temperature. An auxiliary scale gives the relation of the heat drop and the steam velocity, and the Wilson point is marked on the chart. A straight-edge laid across the scales gives the whole of the required properties at once. As an example of the kind of complex problems which can be answered in this way, we quote the following from the article:—In a four-stage turbine the steam expands in thermal equilibrium from 200 lb. per sq. in. absolute and superheat 100° F. to 1·5 lb. per sq. in. absolute; the stage efficiency is 0·65 and the reheat factor 1·045. Required the pressure, specific volume, and quality at the end of each stage. By no means the least interesting part of the article is an appendix showing the methods employed by Mr. Thomson in transforming the equations to the form desired.

DR. GRIFFITH TAYLOR, the Australian meteorologist, delivered during the war courses of lectures on meteorology to the Commonwealth Flying School and at the University of Melbourne, and as a result he is now publishing, through the *Oxford University Press*, "Australian Meteorology, with Sections on Aviation and Climatology." The volume will include chapters on the study of the weather chart, work at a small station, the peculiarities of the Australian rainfall, the special storms and hurricanes of Australia, actual procedure in upper-air research, the discussion of long-distance forecasting and the application of meteorology to aviation, etc.

IN the *Veterinary Review* for February (vol. iv., No. 1) Mr. Fred Bullock contributes an instructive article on the compilation of bibliographies. Full details are given of the proper manner of compiling a bibliography, and a number of examples of correct and incorrect references to journals and other publications are given and criticised.

MESSRS. CROSBY LOCKWOOD AND SON, 7 Stationers' Hall Court, London, E.C.4, have just issued a new select list of books published by them on chemical technology. A copy will be sent to any reader of NATURE post free upon application to this well-known firm of publishers of modern scientific, industrial, and technical books.

Our Astronomical Column.

THE TOTAL SOLAR ECLIPSE OF 1918 JUNE 8.—Vol. lviii., No. 4, of the Proceedings of the American Philosophical Society is entirely taken up with a discussion of the observations made during this eclipse. The photographs taken by the Lowell Observatory Expedition at Syracuse, Kansas, bring out very clearly the connection between the prominences and the coronal arches. It is pointed out that this connection is much easier to trace at sun-spot maximum than at minimum. Dr. Slipher's photographs of the coronal spectrum indicate that coronium is much more abundant in the equatorial than in the polar regions. Messrs. Jakob Kunz and Joel Stebbins were stationed at Rock Springs, Wyoming, and measured the total light of the corona by photo-electric cells. Comparison was made with the full moon through the intermediary of standard candles. Allowing for absorption by the atmosphere, the total light of the corona was 1·07 candle-metres, just half the value found for the full moon. Comparison of the corona with the sky near the sun before and during the eclipse showed that the corona gave 1/10th of the sky light (same area) in full sunshine, and six hundred times the sky light during totality. It is obvious that most of the illumination of the landscape during totality comes, not from the corona, but from the distant regions of the terrestrial atmosphere, which are outside the shadow. Endeavours are being made by Prof. Hale at Mount Wilson to detect the corona in daylight by the use of photo-electric cells.

Mr. John A. Miller, of the Sproul Observatory, describes some researches to detect motion in coronal streamers by comparing plates taken at different stations. Recessions from the sun of 90, 60, and 15 miles per second were indicated for three different streamers. Mr. Miller also states that the forms of many of the streamers can be explained on the supposition that they are projected matter acted on by a repulsive force.

A NOON REFLECTOR.—Prof. C. V. Boys describes in the *English Mechanic* for March 5 an ingenious little instrument which he states to be capable of determining apparent solar time within a second. It is essentially a transit instrument; a small mirror, ¾ in. in diameter, is mounted on an axis about 2 in. long, with cylindrical ends which rest in two Y's, mounted on a stand which is capable of being firmly fixed in a window of southern aspect. Full details and drawings of the various parts are given in the article, with instructions which should enable any person with a mechanical bent to construct it. Small movements for fine adjustment in level and azimuth are allowed for in the design. Some protecting cover and some means of fixing firmly after adjustment is secured are also demanded, as it is somewhat tedious and troublesome to adjust it with high accuracy. The mirror is so small that the reflection of the sun on the opposite wall is fairly well defined, like a pinhole image, and the author states that he has frequently been able to see large sun-spots clearly. There is a certain amount of penumbra, but by practising uniformity in observing either the inside or the outside of the penumbral fringe the time of transit of the sun's centre may be determined to a second. The meridian is marked by a line on the north wall of the room; the noon image of the sun may be brought to the same point at all times of the year by rotating the mirror axis in the Y's.

American Fossil Vertebrate Animals.

AMERICAN palæontologists are making good progress with their detailed studies and descriptions of the original type-specimens of the various species of extinct vertebrate animals found on their continent. Most of the first descriptions were necessarily hurried and superficial, often unaccompanied with figures, and they are scattered in numerous small publications. Later discoveries have indicated more clearly the features that are of special significance and need particular attention in each case, so that new descriptions are of fundamental importance for exactitude in the science. Realising this, Prof. H. F. Osborn has just completed a valuable work by bringing together a series of up-to-date technical descriptions and figures of all the type-specimens of fossil horses from the Oligocene, Miocene, and Pliocene formations of North America (Memoirs of the American Museum of Natural History, new series, vol. ii., part i.). He not only deals with every species on a uniform plan, but also discusses in ample detail the correlation of the various formations from which the fossils were obtained. Besides reproducing the original figures already published, he adds many more, and among these the pencil drawings by two Japanese artists are especially noteworthy. A series of new drawings collected to illustrate the evolution of the upper and lower molars of the horses is a welcome compendium.

Other fossil mammals are described and discussed in the sixth volume of papers on vertebrate palæontology extracted from the Bulletin of the American Museum of Natural History, 1915–17. We noticed some of these contributions at the time of their publication, and we are glad to have them so conveniently collected. Several notes on the mammalian remains of the Lower Eocene by Messrs. W. D. Matthew and W. Granger add to our knowledge of the type-specimens by comparison with later discoveries, which are described and illustrated in detail. The paper on the Eocene Notharctus by Messrs. W. Granger and W. K. Gregory is also fundamentally important for a discussion of the origin of the Primates. In another valuable memoir Dr. Gregory pursues this subject, and reviews our present knowledge of the fragmentary fossils which seem to afford some information as to the origin of man.

The skeleton of Diatryma, a heavy running bird 7 ft. high, from the Lower Eocene of Wyoming, is described by Messrs. Matthew and Granger as representing a new order of uncertain relationships. Some of the Cretaceous Dinosaurs described by Prof. Osborn are also remarkably bird-like; and the wonderfully preserved Corythosaurus described by Mr. B. Brown, though evidently an amphibious Dinosaur related to Iguanodon, has a bony crest which would make the outward shape of its head like that of a cassowary.

In the volume from the American Museum there are also some notes on the gigantic Dinosaurs related to Diplodocus, but a still more important contribution to our knowledge of these reptiles is Prof. R. S. Lull's detailed description of Barosaurus in the Memoirs of the Connecticut Academy (vol. vi., pp. 1–42, pls. i.–vii.). Barosaurus seems to have a longer neck and shorter tail than Diplodocus, but is otherwise very similar to the latter. The gigantic Sauropoda, indeed, are not easily classified, and we still need many more technical descriptions like that before us.

Some of the type-specimens of the Permian and Triassic reptiles are also redescribed and discussed by Baron von Huene and Mr. D. M. S. Watson in the Bulletin of the American Museum; but the most

striking recent addition to our knowledge is a fine skeleton of Dimetrodon from the Permian of Texas, described by Mr. C. W. Gilmore in the Proceedings of the U.S. National Museum (vol. lvi., pp. 525–39, pls. 70–73). Mr. Gilmore has restored the reptile as shown in the accompanying figure, and none of the proportions are hypothetical except the length of the thin end of the tail. The total length is about 7 ft., while the greatest height at the middle of the dorsal crest is nearly 5 ft. It must have been an agile reptile, and the serrated sabre-shaped teeth would be very effective for the capture and tearing-up of its prey. The feet have sharp claws. The remarkable crest on the back is formed by the projection of the greatly elongated neural spines of the vertebræ, as in the existing little lizard, the basilisk, of tropical America, shown in the upper corner of our figure.

FIG. 1.—Restoration of a primitive carnivorous reptile, *Dimetrodon gigas*, from the Permian of Texas, made by Mr. Charles W. Gilmore for the U.S. National Museum, Washington; about one-twelfth natural size. Inset, the existing lizard, *Basiliscus plumifrons*, from Central America, showing dorsal crest formed by projecting neural spines.

The use of this crest is uncertain, but the most plausible suggestion seems to be that the reptile lived among scrubby vegetation, and the outgrowths, protectively adorned, may have helped to conceal it.

A. S. W.

Research in Textile Industries.

RECEIVING its initial impetus from the activities of the University of Leeds, later aspiring to wider activities in the West Riding of Yorkshire, the British Research Association for the Woollen and Worsted Industries has now attained to full status under the Department of Scientific and Industrial Research, and, according to the report for 1918–19 of the council, just published, may claim to be one of the largest, wealthiest, and most active of the associations under the Department. The annual income, apart from special donations and interest, is nearly 12,000*l.*, and it is hoped that ultimately the association will embrace the two thousand firms engaged in wool manufacturing in the British Isles. The outstanding feature of the year covered by the report has been the appointment of a director of research, Major H. J. W. Bliss having taken up his duties on March 24 last year.

Among the interesting matters dealt with in the report are the seven reports on researches or investigations undertaken by the association; the partial engagement of two specialists and the appointment of two investigators; the development of consulting work; the dissociation from the larger educational institutions—particularly the University of Leeds and the Bradford Technical College—and the start on the development of private laboratories at Frizinghall, Bradford; the institution of a library and information bureau and the indexing of past textile publications and research; the formation of two joint committees, one to deal with woollen carding and spinning, and the other with sheep-breeding; the receiving of deputations; and the formation of five local committees for England, Scotland, and Wales.

Reference is also made to the progress of research, especially in the United States and in Germany, attention being directed to the large sums of money spent and the large staffs engaged by individual firms, and the inference drawn that, large as the resources of the British Research Association are, they will have to be much augmented if the requirements of the wool industry are to be satisfactorily met. A little homily

is then given on "The Effect of Neglect in the Past," "Remedying the Neglect," "The Basis of Research," and "Research: What it is not."

It is to be regretted that the report shows a certain lack of appreciation of the conditions under which scientific research and investigations may be conducted. The appointment of a director who comes fresh and unbiased to the wool industry is an experiment well worth watching in view of future developments. But how comes it that the actual laboratories are to be divorced from the Yorkshire University of Leeds? This action appears all the more strange when it is noted that of the seven researches and investigations undertaken, five have been carried out in the University of Leeds; of the four appointments made to the staff, three are from the University of Leeds; and of the two large researches conjointly undertaken, both originated in the University of Leeds, the second being started by drawing upon the University's unique flock of Soay sheep.

It is further somewhat strange to read that "in the simplest matters it is not possible to find information in a correct and authoritative form," in view of the fact that the country which has been specially commended in the report for its highly developed research activities (the United States of America) adopts a Yorkshire text-book as its standard work of reference, and that Australia similarly regards Yorkshire publications on wool. We hope that the tendencies here indicated are only a passing phase, and that ultimately credit will be rendered to those institutions, particularly the University of Leeds and the Bradford Technical College, and individuals who by their labours in the past have made possible the development of this association.

Research work on wool presents such remarkable difficulties that apparently the only possibility of sound progress in the future lies in the closest and most amicable association of all institutions and individuals specially qualified to assist in introducing science and scientific method to the greatest possible extent throughout the wool industries. It may be that the secrecy insisted on by this association is essential in the interests of subscribing members, but the broader interests of research are represented by an approximately equal Government contribution, and it is obvious that these broader interests can best be fulfilled by a well-considered scheme of association between the educational institutions in question and the Research Association.

Climatology of North-west Russia and France.[1]

SINCE the withdrawal of the British Forces from Archangel and Murmansk, the climate of North-west Russia has become a matter of less interest to the average Englishman than was the case six months ago, but to the meteorologist the district remains one of importance. The climatic features of the area in winter must be considered in relation to its intermediate position between the relatively warm waters of the Arctic Ocean and the intense cold of Central Asia. The effect of these two influences is seen in the approximate equality of temperature in January at Alexandrovsk, near the mouth of the Kola River, in the north, and Petrograd in the south, notwithstanding a difference of nearly 10° in latitude between the two stations.

[1] (1) "The Climate of North-west Russia." Pp. 26+4 plates. (London: Meteorological Office, 1919.)
(2) "Études sur le Climat de la France." Deuxième Partie: "Région du Sud-Ouest et du Sud." By A. Angot. Pp. 114+13 plates. (Régime des Pluies.)

The comparative warmth of the Arctic coast is likely to become a matter of considerable economic importance, as it enables the recently developed port of Murmansk to be used for navigation throughout the year. The dates of the forming and breaking-up of ice on the Nova, Dvina, and Onega Rivers and on Lake Onega are shown in a table in the work under notice, where are given not only the mean date, but also the periods within which the date will occur on the average, (*a*) once in two years, and (*b*) once in five years, thus indicating the degree of variability experienced. This may be a matter of nearly as much importance as the actual mean value.

The climatic conditions of North-west Russia are presented in a series of tables giving data for seven stations, while letterpress directs attention to the more important features. It may cause surprise to learn that a temperature of 85° F. has been recorded at Archangel, while the average highest reading for July is 80° F. The percentage of cloudy skies in North Russia is high even in the summer—a feature which is well brought out by diagrams of a novel type, which show the frequency of fog, precipitation, and overcast, cloudy, and clear skies for Archangel and Kola.

Upper-air temperatures are presented for Petrograd, where trustworthy means are available, and also for Kiruna, in Swedish Lapland, where the number of observations is less satisfactory. In the two tables in which these data are set out, increasing height runs in one case up the page, and in the other down. It seems desirable that one or the other of these methods should be standardised. There is much to be said for reversing the older method and following the more natural way by running increasing heights up the page, so that the greater heights are above the smaller. The paper does not aim at being a complete treatise upon the subject of the climate of North-west Russia, but within a small compass a good deal of interesting information is put together.

The second of the two publications under notice is of a different and more specialised type, dealing with but one branch of climatology, namely, rainfall, for the southern and south-western districts of France. This forms the second part of a larger work which is to cover the rainfall of the whole of France, and, as the discussion of the data is left over until the publication of the whole is complete, the present volume contains little but tabulated matter. The region embraced is bounded by the Rhone on the east and by the Pyrenees on the south, while northward it stops somewhat short of the Loire.

The thirty Departments included in the area are represented by some 950 rainfall stations, the mean "density" varying in general in the different regions from ½ to 1 station per 10 km. square. In the main tables each Department is dealt with separately in the following manner:—First are set out brief particulars of the different stations giving height above sea-level and the period covered by the observations. Next are given the mean monthly and annual fall in millimetres for each station reduced to the common period 1851–1900. Finally, for selected stations the proportionate fall in each month of the year is shown. The means from these selected stations show the annual march of rainfall for the Department as a whole, and in this case correction is made for the unequal lengths of the months.

At certain stations, more numerous in some Departments than in others, the rain-gauge is placed upon a roof, which leads to an unsatisfactory exposure. It is pointed out that the errors introduced by such an exposure are proportionately greater in winter than in summer, so that the annual curve is distorted. It is worth noting that the normal height of the rim

of the gauge above the ground is 1·5 to 1·8 metres in France, so that a correction would be necessary before making comparison of the results with British records.

An excellent series of charts at the end of the volume indicates the rainfall distribution in each month and in the year as a whole. In the study of these charts one misses a contour map of the country. The annual fall varies from 500 mm. in two small areas on the shores of the Mediterranean to more than 1500 mm. in the mountainous regions. It is noteworthy that, after the Mediterranean seaboard, parts of the Atlantic coast take a high place among the driest regions of southern and south-western France. This is particularly the case in the summer months. A wise discretion has evidently been used in rejecting stations of doubtful accuracy in the preparation of the district means, and in other ways it is evident that trouble has not been spared to render the results as trustworthy as possible. J. S. D.

Volumetric Testing of Scientific Glassware.

ACCURATE work in the chemical and physical laboratory depends not only on the worker, but also to a large extent on the trustworthiness of his glass measuring apparatus, such as burettes, pipettes, and calibrated flasks. Whilst it is no doubt true that every operator who is master of his craft should be able, on occasion, to verify the accuracy of his measuring instruments, it is also true that both time and practice are required to do it well, to say nothing of the fact that special equipment is necessary for some of the verifications. Hence it is important, both to makers and to users, that facilities should be available for the testing of such instruments by experts, upon whose testimony reliance can safely be placed.

At the National Physical Laboratory apparatus of the kind in question has been tested, in respect of its accuracy, for the past fifteen years, but on a small scale only. Such instruments were mainly obtained from abroad in pre-war days, and it is only within the last two or three years that the making of them has developed appreciably in this country.

With the growth of the industry here it became necessary to make arrangements for testing and certifying glass volumetric apparatus on a larger scale than heretofore. Facilities were therefore provided and regulations drawn up, in co-operation with manufacturers and users of scientific glassware, for carrying out systematically what are known as "Class A" tests—that is, tests on apparatus required to be of the highest degree of accuracy. A pamphlet describing the arrangements and regulations was issued in July, 1918, and a new building has just been completed, with special equipment for dealing with this class of work on a large scale.

Instruments required to be only sufficiently accurate for commercial purposes are designated as "Class B." A permanent scheme for commercial testing of such articles by State institutions, or by other approved bodies, is now under the consideration of the Government. Pending the settlement of this scheme, manufacturers may note that the National Physical Laboratory is prepared to undertake "Class B" tests, which for the present will be carried out at Teddington. It is hoped eventually to arrange for this work to be done at local centres.

A full account of the methods of testing, limits of error allowed, details of construction, and fees charged is given in a new edition of the laboratory pamphlet, "Volumetric Tests on Scientific Glassware." Copies of this pamphlet may be obtained free of charge on application to the Director.

The "Class A" tests are designed for instruments intended to possess the highest degree of accuracy required in scientific use. Whilst the "Class B" tests are less stringent, the limits of error assigned are such as all graduated apparatus of good commercial quality should comply with, and are necessary for obtaining satisfactory results in ordinary routine analysis.

It is very desirable that the scientific glass-making industry developed in this country during the war should remain as a permanent asset. To attain this end the graduated apparatus produced should be not only well made, but trustworthy in respect of accurate calibration. From the maker's point of view, the advantage of having apparatus guaranteed by an impartial institution is invaluable for establishing a reputation for accuracy. As regards users, they will no doubt be glad to know that it is now possible to obtain apparatus the correctness of which has been impartially verified. The monogram of the National Physical Laboratory is the hall-mark of British scientific glassware so far as accuracy of measurement is concerned.

University and Educational Intelligence.

ABERDEEN.—Mr. W. G. Craib, formerly assistant at Kew, and now of the botanical department, Edinburgh University, has been appointed to the chair of botany vacant by the death of Prof. J. W. H. Trail.

BIRMINGHAM.—Mr. A. A. Dee has been appointed an assistant lecturer in physics.

CAMBRIDGE.—The governing body of Emmanuel College offers to research students commencing residence at the college in October, 1920, two exhibitions, each of the annual value of 50*l*. and tenable for two years and, on the recommendation of the student's director of studies, for such longer period as the degree course may require. The governing body may also make additional grants to students whose means are insufficient to cover the expense of residence at Cambridge or whose course of research may entail any considerable outlay in the provision of apparatus or materials. The exhibitions will be awarded at the beginning of October, and applications should be sent so as to reach the Master of Emmanuel (The Master's Lodge, Emmanuel College, Cambridge) not later than September 18.

The new statute authorising the degree of Doctor of Philosophy for Research has been approved by his Majesty the King in Council, and regulations giving effect to the new statute will be offered for acceptance at the first Congregation in the Easter term.

Mr. F. B. Smith, of Downing College, has been appointed reader in estate management.

Vacancies are announced in the Cayley lectureship in mathematics and in the University lectureships in physiology and zoology. Candidates must apply to the Vice-Chancellor by April 20.

EDINBURGH.—In consequence of the appointment of Mr. W. G. Craib, of the botanical department, to the chair of botany in the University of Aberdeen, it has been arranged as a matter of urgency that Sir George Watt, formerly professor of botany in the University of Calcutta, deliver the course of lectures on Indian forest trees during the summer term.

Mr. James Templeton has been appointed lecturer in botany in succession to Mr. Pealling (resigned), and Dr. Bella D. MacCallum full-time assistant in the same department.

With the assistance of the Scottish Committee of the Royal Aeronautical Society, the services of four lecturers had been obtained to give a series of lectures

on aeronautics in connection with the engineering classes at the Universities of St. Andrews, Glasgow, and Edinburgh. The University Court voted a grant of 50*l*. to defray the cost of the lectures in Edinburgh, and suggested that the lectures should be open to the public.

M. l'Abbé Breuil, of Paris, has been appointed Munro lecturer on prehistoric archæology for the academical year 1920–21.

LIVERPOOL.—The University, through its Chancellor, Lord Derby, has just issued an appeal to its constituency, the counties of Cumberland, Lancashire, Cheshire, and North Wales, for funds that will enable it to come abreast of present needs. Some of the laboratories have been in existence since 1881, and are obviously inadequate, while all of them are now too small; thus the practical course in elementary physics is being repeated eleven times each week. The library needs to be extended; the chemical laboratories are so overcrowded that work is being carried on in Army huts; new departments are contemplated and interesting developments are being thought out. A chair in the mathematical theory of statistics, a ship-model tank, a department of colloidal chemistry, and a department of marine food industry are among the "futurist" ideas that make this appeal so relevant to a great industrial and commercial centre. It is hoped that the sum of a million pounds may be obtained, and of this about 500,000*l*. is urgently required for pressing expansions. Already about 200,000*l*. has been promised.

ON Saturday last, March 20, the third annual dinner of the metallurgy department of the Sir John Cass Technical Institute was held, Mr. G. Patchin, the head of the department, being in the chair. Dr. C. A. Keane, the principal, replying to the toast of the institute, stated that at the present time there are more than a thousand individual students attending the various courses. In 1904 there were three courses and twenty-two students in the metallurgy department, and this year there are eleven courses and one hundred and twenty students.

ONE of the most valuable provisions of the new Army scheme is that which relates to the education of the rank and file. The intention is to provide men in the Army with an educational training equal, or even superior, to what is available in civilian life. Every officer in command of a company will be held responsible for the instruction of his men, not only in drill and discipline, but also in the class-room and workshop, and the result will certainly be increased intelligence and efficiency. For the introduction of this substantial reform Col. Lord Gorell, who since 1918 has been Deputy Director of Staff Duties (Education) at the War Office, Sir Henry Hadow, and Mr. P. A. Barnett are largely responsible, and they are to be congratulated cordially that the scheme of Army certificates of education is to come into operation on July 1, 1921. Four classes of certificates are to be awarded on the results of examination. For the third-class certificate candidates must be able to read intelligently a selected piece of English prose, write a simple letter, work simple sums up to and including vulgar fractions in reference to concrete examples, and answer questions on a course of citizenship and history. The second-class certificate will apparently require a standard of attainment comparable with those of the former Preliminary Local Examinations of Oxford and Cambridge; and the first class, involving English, mathematics, geography and map-reading, and (optional) an ancient or modern language, approximately that of the First School Examination. By taking, in addition, two or three single subjects from different groups, a special certificate may be obtained. Various practical subjects may be taken for the second-class certificate, and the groups for the special certificate include mechanics, chemistry, physics, botany, zoology, geology, physiology, civil, mechanical, and electrical engineering, agricultural chemistry, and commerce. We shall watch with close attention the application and results of this educational scheme.

Societies and Academies.

LONDON.

Royal Society, March 11.—Sir J. J. Thomson, president, in the chair.—W. G. **Duffield**, T. H. **Burnham**, and A. A. **Davis**: The pressure upon the poles of metallic arcs, including alloys and composite arcs. In a previous communication (Phil. Trans., A, ccxx., p. 209, 1919) the authors showed that the poles of a carbon arc behaved as though they repelled one another, and methods were described by which the pressure upon each pole could be measured. Reasons were given for attributing this effect to the reaction consequent upon the emission of electrons from the poles under the influence of thermionic or photo-electric action. The present experiments relate to arcs between iron, copper, and silver terminals, the rate of variation of the pressure with current density being measured for the anodes and cathodes. The pressures were greater than in the carbon arc, that within the copper arc being the largest. Assuming that the pressure is due to the projection of electrons, a comparison between the kinetic energy of the electron and that of the metallic atom at the temperature of the poles showed sufficient agreement to suggest that the electrons before projection were in thermal equilibrium with the metal of the pole. The reactions upon electrodes composed of an alloy of silver and copper were also measured, likewise those within an arc between a silver and a carbon pole. In this case the pressure was determined mainly by the material of the pole under examination. The problem of the mechanism whereby a gas may be heated is briefly discussed. Some account is also given of the variation in the potential difference between the poles when the material of one is altered.—J. H. **Vincent**: Further experiments on the variation of wave-length of the oscillations generated by an ionic valve due to changes in filament current. Eccles and Vincent have found that in an oscillatory circuit maintained by a thermionic valve with a grid coil coupling, the wave-length has a maximum value for a certain filament current. This effect is studied further in this paper. In order to vary the filament current, rheostats were designed and used in which the change of resistance was unaccompanied by any sensible change in the self-induction of the filament circuit. The methods of measuring the change of wave-length due to the variation of filament current were different from that employed by Eccles and Vincent, but it was found that the results obtained were independent of the particular method by which the wave-length was studied. It is suggested that changes in several of the variables of a valve-maintained circuit produce effects of the same sign on the wave-length and the amplitude of the oscillations. The wave-length and amplitude decrease with the decrease of the grid voltage or of the plate voltage. They also decrease when the coupling of the grid coil with the main oscillator coil decreases. Increasing the resistance in either the condenser branch or the induction branch of the main oscillating circuit lessens the amplitude and wave-length; while altering the filament current

in either direction from that giving the maximum wave-length gives also a decreased amplitude.—H. A. **Daynes**: The theory of the katharometer. A historical introductory note by Dr. G. A. Shakespear gives a description of the katharometer and an account of its development by him for hydrogen purity measurements and similar work in connection with lighter-than-air craft. The paper discusses the conditions which determine the temperature of the hot wire in the katharometer cell, and shows that loss of heat by conduction through the gas is the most important factor, convection and radiation being quite unimportant. Equations are given expressing the experimental law of heat loss in a single katharometer wire, and these are applied to the case of two wires in parallel in the arms of a Wheatstone bridge. These equations are then used to show what are the conditions for greatest sensitiveness and precision in various cases arising in practice.—H. A. **Daynes**: The process of diffusion through a rubber membrane. The nature of diffusion of gases through rubber membranes is discussed in the light of some recent work. This all points to a simple process, determined by the case of diffusion through the rubber, and by the absorption of the gas by the rubber. This is introduced mathematically into the problem of diffusion through a membrane. The unsteady state is considered, in which the membrane, after being exposed to air, is suddenly exposed on one side to, say, hydrogen, and the rate of emission of hydrogen from the other side calculated. The passage of gas through the material is treated purely as a diffusion problem, the boundary conditions only being determined by absorption. It is shown that measurements of the permeability of a membrane and of the lag on reaching a steady state are sufficient for the determination of both absorption and diffusion constants. Experiments are described in which these conditions are fulfilled. The measurements of the diffusion are made by means of a katharometer. From these experiments the constants of diffusion and absorption for hydrogen, nitrogen, oxygen, carbon dioxide, nitrous oxide, and ammonia are determined. Temperature coefficients for the constants are given for hydrogen, and the high temperature coefficient of permeability of rubber is shown to be due chiefly to the high temperature coefficient of the diffusion constant. The extraordinarily high permeability of rubber to carbon dioxide, ammonia, etc., is shown to be due entirely to the high absorption. A relation is also suggested between absorption and critical temperature of the gas.

Physical Society, February 27.—Prof. W. H. Bragg, president, in the chair.—T. **Smith**: The balancing of errors. In calculating functions from Taylor expansions or otherwise, the results obtained by summing any finite number of terms will differ to a greater or less extent from the true results. It is shown in the paper that by suitable modifications of the coefficients the results obtained, even when comparatively few terms of the expansion are taken, can be made to approximate very closely to the true results for all values of the variable between selected limits.—Dr. N. W. **MacLachlan**: Notes on the testing of bars of magnet steel. The paper describes the results of experiments with the Ewing double permeameter. It is shown that the assumption underlying the theory of the method, viz. that the end effects are the same with the long and short bars, is not justified, and that the value of H, as found by calculation on this assumption, is in error. The error did not, however, exceed 1 per cent. for any of the bars tested, but the author concludes that the method is inferior as regards accuracy and convenience to the differential-coil method.—G. D. **West**: The forces acting on heated metal-foil surfaces in rarefied gases. The present paper arises out of two previous papers by the author on the pressure of light (Proc. Phys. Soc., xxv., p. 324, 1913, and xxviii., p. 259, 1916), and consists of an experimental investigation of the nature of certain peculiar movements of strips of thin metal foil surrounded by rarefied gases and exposed to radiation. The experiments deal chiefly with phenomena at gas pressures below 1 cm. of mercury, and it is shown that the apparently diverse results obtained can be connected by a theory based on the work of a previous paper (Proc. Phys. Soc., xxxi., p. 278, 1919). The author concludes that at the highest rarefactions the pressures on the strips arise from the fact that, if differences of temperature exist in an enclosure, the pressure of the gas is not uniform, but varies approximately as the square root of the latter's absolute temperature. The simple conditions that exist at low gas pressures are complicated at the higher pressures by gas currents which differ fundamentally from convection currents, but are closely connected with the phenomena of thermal transpiration.

March 12.—Prof. W. H. Bragg, president, in the chair.—F. H. **Newman**: Absorption of gases in the electric discharge tube.—J. S. G. **Thomas**: A directional hot-wire anemometer. The instrument consists of two fine platinum wires mounted close together, and forming two of the arms of a Wheatstone bridge. These are heated by the current in the bridge. When a stream of gas moves in a direction perpendicular to the wires, but parallel to the plane containing them, the leading wire is cooled, while the second wire, being shielded by the first, is not cooled so much, and may actually be heated on account of the air flowing past it being warmed by the first wire. A deflection of the galvanometer is obtained, therefore, which is reversed if the flow of gas is in the reverse direction. The instrument is much more sensitive than the non-directional hot-wire anemometer.

Linnean Society, March 4.—Dr. A. Smith Woodward, president, in the chair.—R. H. **Compton**: A contribution to our knowledge of the botany of New Caledonia. The subject of this communication is the collection made by Mr. Compton in New Caledonia and the Isle of Pines during 1914 with the aid of money grants from the Royal Society, the Percy Sladen Trust, and the Wort's Travelling Fund of Cambridge University. The specimens collected have been presented to the British Museum, and the greater part have been worked out in the department of botany at that institution. Dr. Rendle gave a short account of the position and physical character of the island, and referred to previous work on its flora and its general characters. Important features are the igneous rocks which form a mountain chain of gneiss in the north-east, and the serpentine formation which covers the southern portion and occurs in larger or smaller areas throughout the island. The flora is rich, and the proportion of endemic forms exceptionally high. The main affinities of the flora are with Indo-Malaya and South-East Australia, the former represented chiefly in the forest regions and the latter in the scrub and savannah regions; and a study of it suggests that New Caledonia is a very ancient land mass which has been isolated for a very long period. Dr. Rendle also gave a *résumé* of Mr. Compton's account of the ferns and gymnosperms. The latter are of great interest; they number about twenty-seven, and are all endemic. Mr. Baker referred to a number of interesting specimens among the dicotyledonous flowering plants, which included

many novelties. Miss Lorrain Smith gave an account of the lichens, which include a new genus and a fair proportion of new species. Miss E. M. Wakefield referred to the fungi, the geographical distribution of which showed points of interest; and Miss G. Lister described the small collection of Mycetozoa.

Geological Society, March 10.—Mr. R. D. Oldham, president, in the chair.—Prof. A. H. **Cox** and A. K. **Wells**: The Lower Palæozoic rocks of the Arthog-Dolgelley district (Merionethshire). This paper gives an account of the geology of the country between the Cader Idris range and the Mawddach Estuary. The physiography of the district was described, and a summary of the work of previous investigators given.

MANCHESTER.

Literary and Philosophical Society, February 17.—Sir Henry A Miers, president, in the chair.—Dr. T. Graham **Brown**: The function of the brain. The activity of an animal, as seen by an observer, consists in movements of its limbs, changes of its attitude, changes in its expression, and so on. This activity is usually called "behaviour." In itself the action is a physiological one, and may be analysed and described in terms of physiological mechanism. It is also used as an *index* of the mental processes. The separate movements of the parts of the body are *integrated* by the nervous system in the total behaviour. This integration may occur at different levels in the central nervous system. The great brain must be present if the animal is to exhibit all the finer shades of behaviour which characterise the normal animal. The two general methods of examination were described and illustrated by experimental observations. Brain injuries and their results in men and animals, with consequential paralysis, and the theory of the "cerebral localisation of functions" were discussed.

Literary and Philosophical Society (Chemical Section), February 27.—Mr. R. H. Clayton, chairman, in the chair.—J. **Allan**: Engineering as applied to the buildings and plant in chemical works.

DUBLIN.

Royal Dublin Society, February 24.—Dr. F. Hackett in the chair.—Prof. Wm. **Brown**: Note on the decay of magnetism in bar magnets. Twenty-one bar magnets of different chemical composition were retested for magnetic moment per gram after being laid aside for ten years. The most retentive were found to be magnets with about 1 per cent. of C. and those with about 3 per cent. of Cr. The general results show that in ten years the manganese group lost about 25 per cent. of their magnetism, the tungsten group 20 per cent., and the chromium group about 28 per cent.—T. G. **Mason**: The inhibition of invertase in the sap of *Galanthus nivalis*. The inversion of sucrose in the sap extracted from the leaves of *Galanthus nivalis* takes place with extreme slowness, so that at the end of five days, at a temperature of 29° C., it is still incomplete. The delay is observed whether the sap is pressed from untreated leaves or from leaves the cells of which have been rendered permeable by exposure to intense cold or to toluene vapour; but the delay is least marked in the sap extracted by the first method. It is shown that inversion such as occurs is due neither to the acids of the cell-sap nor to the enzymes of organisms external to the cells, and hence the presence of invertase in the sap seems established. Efforts were made to demonstrate the presence of an invertase-inhibitor by dialysis, and by testing the effect of the sap on yeast-invertase, with negative results. Possibly the greater part of the invertase of the sap is thrown down with the colloids coagulated by extraction, especially during exposure to cold or to toluene vapour. The inversion of the sucrose was traced by thermo-electric observations of the depression of freezing point of the sap. These observations usually showed a comparatively rapid inversion during the first few hours, followed by a slight reversal or suspension of the process for the next few hours, and then a steady inversion at a very slow rate. The reversal is remarkable, and may be attributed to a condensation of hexoses to form sucrose or to oxidation of the hexoses.

Books Received.

Spring Songs. By T. J. W. Henslow. Pp. 54. (London: Electrical Press, Ltd.) 1*s*. 6*d*. net.

The Propagation of Electric Currents in Telephone and Telegraph Conductors. By Prof. J. A. Fleming. Third edition. Pp. xiv+370. (London: Constable and Co., Ltd.) 21*s*. net.

The Arctic Prairies. By E. Thompson Seton. Pp. xii+308. (London: Constable and Co., Ltd.) 8*s*. 6*d*. net.

Paper Making and its Machinery. By T. W. Chalmers. Pp. xi+178+vi plates. (London: Constable and Co., Ltd.) 26*s*. net.

Mathematical Papers for Admission into the Royal Military Academy and the Royal Military College, and Papers in Elementary Engineering for the Royal Air Force for the Years 1910–1919. Edited by R. M. Milne. (London: Macmillan and Co., Ltd.) 10*s*. 6*d*.

Annual Reports on the Progress of Chemistry for 1919. Vol. xvi. Pp. ix+234. (London: Gurney and Jackson.) 4*s*. 6*d*. net.

A Manual of Elementary Zoology. By L. A. Borradaile. Third edition. Pp. xviii+616+xxi plates. (London: Henry Frowde and Hodder and Stoughton.) 18*s*.

The Ghost World: Its Realities, Apparitions, and Spooks. By J. W. Wickwar. Pp. 158. (London: Jarrolds, Ltd.) 2*s*. 6*d*. net.

Treatise on General and Industrial Inorganic Chemistry. By Prof. E. Molinari. Second edition. Translated from the fourth Italian edition by T. H. Pope. Pp. xix+876+2 plates. (London: J. and A. Churchill.) 42*s*. net.

Industrial Organic Analysis. By P. S. Arup. Second edition. Pp. xi+471. (London: J. and A. Churchill.) 12*s*. 6*d*. net.

Electricity: Its Production and Applications. By R. E. Neale. Pp. viii+136. (London: Sir Isaac Pitman and Sons, Ltd.) 2*s*. 6*d*. net.

Aviation: Theorico-Practical Text-book for Students. By B. M. Carmina. Pp. ix+172. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 11*s*. net.

The Link between the Practitioner and the Laboratory. By C. Fletcher and H. McLean. Pp. 91. (London: H. K. Lewis and Co., Ltd.) 4*s*. 6*d*. net.

A Memorial Volume containing an Account of the Photographic Researches of Ferdinand Hurter and Vero C. Driffield. By W. B. Ferguson. Pp. xii+374. (London: The Royal Photographic Society of Great Britain.) 25*s*.

Common Diatoms. By T. K. Mellor. Pp. 16+ plates. (London: W. Wesley and Son.) 6*s*. net.

Legal Chemistry and Scientific Criminal Investigation. By A. Lucas. Pp. viii+181. (London: E. Arnold.) 10*s*. 6*d*. net.

A Map of Europe and Africa (on Mercator's Projection), having Special Reference to Forest Areas

and the Distribution of the Principal Timber Trees. By J. H. Davies. (Edinburgh: W. and A. K. Johnston; London: Macmillan and Co., Ltd.) 8s. net.

A Map of South America, Central America, and the West Indies (on Mercator's Projection), having Special Reference to the Principal Forest Regions and the Chief Timber Trees. By J. H. Davies. (Edinburgh: W. and A. K. Johnston; London: Macmillan and Co., Ltd.) 8s. net.

Cytology, with Special Reference to the Metazoan Nucleus. By Prof. W. E. Agar. Pp. xii+224. (London: Macmillan and Co., Ltd.) 12s. net.

Tuberculosis and Public Health. By Dr. H. Hyslop Thomson. Pp. xi+104. (London: Longmans and Co.) 5s. net.

Macmillan's Geographical Exercise Books: Key to Physical Geography. With Questions by B. C. Wallis. Pp. 48. (London: Macmillan and Co., Ltd.) 4s. 6d. net.

The Sea Fisheries. By Dr. J. T. Jenkins. Pp. xxxi+299. (London: Constable and Co., Ltd.) 24s. net.

The Flora of Chepstow. By W. A. Shoolbred Pp. x+140. (London: Taylor and Francis.) 10s. 6d. net.

Type Ammonites. By S. S. Buckman. The Illustrations from Photographs mainly by J. W. Tutcher. Part xxi. Pp. 9–16+14 plates. (London: W. Wesley and Son.)

Diary of Societies.

THURSDAY, MARCH 25.

INSTITUTION OF NAVAL ARCHITECTS (at Royal Society of Arts), at 11.—Sir Alfred Yarrow: Notes on our Economic Position as a Shipbuilding Country.—J. Anderson: Further Notes on the Dimensions of Cargo Steamers.—Dr. J. Bruhn: Freeboard and Strength of Ships.

INSTITUTION OF NAVAL ARCHITECTS (at Royal Society of Arts), at 3.—P. R. Jackson: The Stabilisation of Ships by means of Gyroscopes.—Prof. K. Suyehiro: Yawing of Ships caused by Oscillation amongst Waves.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Stephen Graham: The Hope for Russia.

ROYAL SOCIETY, at 4.30.—Prof. A. R. Forsyth: Note on the Central Differential Equation in the Relativity Theory of Gravitation.—R. D. Oldham: The Frequency of Earthquakes in Italy in the Years 1896 to 1914.—A. F. Dufton: A New Apparatus for Drawing Conic Curves.—Capt. J. W. Bispham: An Experimental Determination of the Distribution of the Partial Correlation Coefficient in Samples of 30.

CHEMICAL SOCIETY (Annual General Meeting), at 5.—Sir James J. Dobbie: Presidential Address.

ROYAL COLLEGE OF PHYSICIANS, at 5.—Sir John R. Bradford: The Clinical Experiences of a Physician during the Campaign in France and Flanders, 1914-1919 (Lumleian Lecture).

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Dr. E. Sloan Chesser: Adolescence and the Continuation Schools.

INSTITUTION OF ELECTRICAL ENGINEERS (at Institution of Civil Engineers), at 6.—Discussion on:—(*a*) The Electrical Equipment of Artisan Dwellings (with Introductory Paper by L. Milne). (*b*) The Report of the Farthing Sub-Committee of the Wiring Rules Committee of the Institution.

CONCRETE INSTITUTE, at 7.30.—E. L. Hall: Steelwork in the new London County Hall.

INSTITUTION OF NAVAL ARCHITECTS (at Royal Society of Arts), at 7.30.—C. I. R. Campbell and C. H. May: The Effect of Size upon Performance of Rigid Airships.—Prof. E. G. Coker and A. L. Kemball, jun.: The Effects of Holes, racks, and other Discontinuities in Ships' Plating.

CHEMICAL SOCIETY (Informal Meeting), at 8.

FRIDAY, MARCH 26.

INSTITUTION OF NAVAL ARCHITECTS (at Royal Society of Arts), at 11.—Engr.-Com. H. B. Tostevin: Experience and Practice in Mechanical Reduction Gears in Warships.—J. J. King-Salter: The Balancing of Rotors and Determining the Position and Amount of the Balancing Weights.—Prof. T. H. Havelock: Turbulent Fluid Motion and Skin Friction.

PHYSICAL SOCIETY OF LONDON, at 5.—Prof. A. S. Eddington and Others: Discussion on Einstein's Theory of Relativity.

WIRELESS SOCIETY OF LONDON (at Institution of Civil Engineers), at 6.—Capt. L. A. T. Broadwood: Harmonics in Continuous Wave Transmissions (Illustrated by Lantern Slides and Experiments).

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—P. L. Young and Others: Discussion on Foundry Memories.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—W. A. Tookey: The Future of the Gas Industry.

MEDICAL OFFICERS OF SCHOOLS ASSOCIATION (at 11 Chandos Street, W.), at 8.—Dr. G. H. Lock and Others: Discussion on Care of Minor Ailments in School Children.

ROYAL SOCIETY OF MEDICINE (Epidemiology and State Medicine Section), at 8.30.—Dr. S. Monckton Copeman: The Relationship of Smallpox and Alastrim.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir J. J. Thomson: The Scientific Work of the late The Right Hon. Lord Rayleigh.

SATURDAY, MARCH 27.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir J. J. Thomson: Positive Rays.

MONDAY, MARCH 29.

INSTITUTION OF AUTOMOBILE ENGINEERS (Graduate Section), at 8.—W. D. Pile: The Use of Benzol.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—Delissa Joseph: Higher Buildings for London.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Commander D. G. Hogarth: War and Discovery in Arabia.

TUESDAY, MARCH 30.

TECHNICAL INSPECTION ASSOCIATION (at the Royal Society of Arts), at 5.—Annual General Meeting.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Sir Frank Colyer: Exhibition of Skulls of *Macacus rhesus*.—Dr. C. F. Sonntag: Abnormalities of the Abdominal Arteries of a Young Panda.—A. Loveridge: Notes on East African Lizards collected 1915-1919, with Descriptions of a new Genus and Species of Skink, and a new Subspecies of Gecko.—A. M. Altson: The Life-history and Habits of Two Parasites of the Blowfly.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Lantern Meeting) at 7.—E. W. H. Piper: Gloucester Cathedral.

ILLUMINATING ENGINEERING SOCIETY (at Royal Society of Arts), at 8.—J. W. T. Walsh and Others: Discussion on Motor-car Headlights in relation to Traffic Requirements.

RÖNTGEN SOCIETY (in X-ray and Electrical Departments, St. Bartholomew's Hospital), at 8.15.

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